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PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY. VOLUME III. APPENDI--ETC(U)

1967

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PASCAGOUL

Comprehensive Basin Study

PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

VOLUME INDEX

6

PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY.

Volume III.

APPENDIX D.

ENGINEERING STUDIES FOR MAJOR RESERVOIRS

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Prepared by the
MOBILE DISTRICT, CORPS OF ENGINEERS
DEPARTMENT OF THE ARMY

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INTRODUCTION

This appendix, prepared by the Corps of Engineers, is devoted principally to engineering studies for major reservoirs in the early-action program and to related investigations and material. It contains Corps authorities for participation in the Pascagoula River Comprehensive Basin Study; brief summaries of prior reports; summaries of hydrology studies concerning water availability, storm types, previous storms and floods, low flow and flood flow frequencies; flood damage studies; general design criteria; project formulation studies and descriptions of early-action major reservoir projects; navigation studies; and hydroelectric power studies. Also included are sedimentation studies performed for the Corps of Engineers by the Department of Agriculture.

APPENDIX D

TABLE OF CONTENTS

Subject	Page No.

LIST OF TABLES

Table No.	Title	Page No.
22	Initial cost and annual charges, waterway on Tallahala Creek to Laurel ---------------------	D-127
23	Initial cost and annual charges, waterway on Chickasawhay River-Okatibbee Creek to Meridian -	D-128
24	Waterway plans A, B, and C, summary of first costs and annual charges ----------------------	D-129
25	Comparative statement of traffic, Pascagoula River --	D-131
26	Potential waterway commerce for tributary area --	D-132
27	Traffic subjected to rate analysis -------------	D-133
28	Prospective waterway tonnages and savings based on present commerce -------------------------	D-135
29	Economic indicators used in projecting waterway commerce -------------------------------------	D-136
30	Factors used in projecting waterway tonnages and savings over life of project ---------------	D-137
31	Projected waterway tonnages and savings by commodity groups for years 1980, 2015, and 2030 --	D-138
32	Summary of current and projected waterway tonnages and savings --------------------------	D-139
33	Waterway plans A, B, and C, comparison of benefits and costs ---------------------------	D-139
34	Locations and drainage areas of sites investigated for power ------------------------------	D-141
35	Mean monthly flows in second feet per square mile - Escatawpa River near Wilmer, Ala. -------	D-142
36	Mean monthly flows in second feet per square mile - Bucatunna Creek at Denham, Mississippi --	D-143
37	Mean monthly flows in second feet per square mile- Chickasawhay River at Waynesboro, Mississippi ----------------------------------	D-144
38	Mean monthly flows in second feet per square mile - Black Creek near Benndale, Mississippi --	D-145
39	Pertinent data used in capacity determination ---	D-146
40	Estimated energy from considered power projects -	D-153
41	Estimated at-site power benefits for considered power projects ---------------------------------	D-154
42	Principal powerhouse dimensions and elevations --	D-157
43	Summary of first costs, annual charges, benefits and benefit-to-cost ratios for considered single-purpose power projects -----------------	D-158
44	Summary of first costs, annual charges, benefits and benefit-to-cost ratios for specific power facilities -----------------------------------	D-159

LIST OF FIGURES

SECTION 1 — AUTHORITY AND PRIOR REPORTS

This section presents the authority for the Corps of Engineers' participation in the comprehensive study of the Pascagoula River Basin and brief summaries of pertinent prior reports.

AUTHORITY

This study of the Pascagoula River and tributaries was originally initiated in 1962 by the Corps of Engineers under the authority of two resolutions adopted 14 March 1961 by the Committee on Public Works of the United States Senate, and resolutions adopted on 7 June 1961 and 15 August 1961 by the Committee on Public Works of the House of Representatives, United States. Two of these resolutions directed review of prior reports with a view to determining the feasibility of construction of barge canals from Meridian, Hattiesburg, Laurel, or other communities along those streams to the Gulf of Mexico. The other two resolutions directed a review of prior reports to determine whether the recommendations contained therein should be modified in any way at this time. The resolutions are as follows:

> "Resolved by the Committee on Public Works of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 12, 1902, be, and is hereby, requested to review the reports of the Chief of Engineers on the Pascagoula, Leaf and Chickasawhay Rivers, and Tallahala Creek, and tributaries, Mississippi, transmitted to Congress on July 17, 1951, and other reports, with a view to determining whether modification of the recommendations contained therein is advisable at the present time, with particular reference to the feasibility of construction of barge canals from Meridian, Hattiesburg, Laurel, or other communities along those streams, to the Gulf of Mexico."

> "Resolved by the Committee on Public Works of the United States Senate, That the Board of Engineers for Rivers and Harbors, created under Section 3 of the River and Harbor Act, approved June 12, 1902, be, and is hereby, requested to review the reports of the Chief of Engineers on Pascagoula River and tributaries, Mississippi and Alabama, transmitted to Congress on April 21, 1944, and other reports, with a view to determining whether the recommendations contained therein should be modified in any way at this time, in view of the recent severe floods in the area."

"Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the reports of the Chief of Engineers on Pascagoula River and tributaries, Mississippi and Alabama, transmitted to Congress on 21 April 1944, and other reports, with a view to determining whether the recommendations contained therein should be modified in any way at this time, in view of the recent severe floods in the area."

"Resolved by the Committee on Public Works of the House of Representatives, United States, That the Board of Engineers for Rivers and Harbors be, and is hereby, requested to review the report of the Chief of Engineers on Pascagoula, Leaf and Chickasawhay Rivers and Tallahala Creek and tributaries, Mississippi, dated 22 June 1951 and other reports, with a view to determining whether the recommendations contained therein should be modified in any way at this time."

Following the 1961 report of the Senate Select Committee on National Water Resources and subsequent Executive Branch actions, the investigation of the Pascagoula River Basin was selected as one of the initial Type 2 comprehensive basin studies through action of the Interdepartmental Staff Committee of the then ad hoc Water Resources Council. Since all water and related land resource requirements were to be considered, the participation and contributions of a number of agencies were required. Therefore, agencies of the Department of Agriculture, Department of the Army, Department of Commerce, Department of Health, Education, and Welfare, Department of the Interior, Department of Transportation, and the Federal Power Commission joined in the study and participated in accordance with their pertinent statutory responsibilities. The Corps of Engineers, Department of the Army, was designated as study leader; a plan of investigation was developed outlining scope, agency responsibilities, and schedules; and coordinated budget estimates were submitted through the Water Resources Council.

PRIOR REPORTS

There have been a total of 15 reports prepared by the Corps of Engineers on all or parts of the Pascagoula River system. Those pertinent to this study are described briefly in the following paragraphs.

One of the principal reports under review is the unpublished survey report of 21 April 1944 on Chunky Creek, Chickasawhay and Pascagoula Rivers, Mississippi, which presented results of studies for the improvement of these streams for navigation, flood control and

hydroelectric power. Items considered in the report included a dam and reservoir on Chunky Creek to provide storage for flood control, stream flow regulation for power, and a lake for recreation; a dam and reservoir on the Chickasawhay River near Waynesboro, Mississippi, to impound and regulate stream flow for power generation and provide a lake for recreation; and channel clearing in the Chickasawhay River for 25 miles below the Waynesboro Dam for the alleviation of flood conditions. A navigable channel from the Gulf of Mexico at Pascagoula to Meridian was also considered. The Chief of Engineers concluded that improvement of these rivers in the interest of navigation, flood control, and hydroelectric power should not be undertaken by the United States at that time.

A review was also made of the unpublished survey report of 15 May 1944 on Leaf and Bowie Rivers and tributaries. The plans presented in that report included protection of the Hattiesburg area between the Leaf and Bowie Rivers by levees, 310 miles of channel clearing and snagging on the Leaf and Bowie Rivers and Okatoma and Tallahala Creeks, protection of areas along the Leaf River and Tallahala and Okatoma Creeks by means of levees, and a dam and reservoir on the Leaf River above Hattiesburg for flood control and power. These projects were not economically justified at that time.

Another report reviewed was the unprinted "Preliminary Examination of Pascagoula, Leaf, and Chickasawhay Rivers, Mississippi," submitted to Congress on 17 July 1951. The provision of a 9-foot depth for navigation on the Pascagoula River and tributaries from Pascagoula Harbor to Meridian, Hattiesburg, and Laurel was considered in the report. Since the considered works were not found to be economically justified, the Chief of Engineers recommended that the improvements not be undertaken at that time.

Several other reports pertinent to the present report have been submitted on streams within the Pascagoula River Basin. The Secretary of War submitted to Congress on 23 September 1937, a preliminary examination of the flood problem along the Chickasawhay River and tributaries which is contained in House Document No. 410, 75th Congress, 2nd Session. The Chief of Engineers recommended that a survey be made to develop plans and estimates of costs and benefits for the control of floods in the basin.

A report recommending channel enlargement and clearing and snagging along Sowashee Creek at Meridian, Mississippi, was submitted on 1 September 1951. The project was constructed under the Flood Control Act of 1948, as amended by Section 212 of the Flood Control Act of 1950. This project was completed in 1955.

A report was submitted on 14 October 1953 recommending channel rectification along two miles of Gordon's Creek in Hattiesburg, Mississippi. The construction of this project was authorized and funds allotted by the Chief of Engineers in accordance with Section 212 of the Flood Control Act of 1950. However, necessary rights-fo-way for the project could not be obtained by local interests; therefore, the project authorization was cancelled and funds revoked in July 1956. Another report with a revised plan for flood protection along Gordon's Creek was submitted in June 1963. The report was returned for consideration of a broader plan requiring more land for rights-of-way. Further action on the report has been deferred until the required items of cooperation can be furnished by local interests.

The latest report on the Pascagoula River Basin, published as House Document No. 549, 87th Congress, 2nd Session, recommended the construction of a reservoir on Okatibbee Creek near Meridian, Mississippi, for flood control, water supply, recreation and related purposes. This reservoir was authorized by the Flood Control Act of 1962, and advance planning for construction was initiated in 1963. Prior to initiation of construction in 1965, water quality control was added as a project purpose. The project is nearing completion and will be placed in operation in 1968.

SECTION 2 — HYDROLOGY

PART A — GENERAL

SCOPE

Presented in this section are summaries of basic hydrologic data pertinent to the Pascagoula River Comprehensive Basin Study and summaries of hydrologic studies made by the Corps of Engineers for planning water control projects. The studies include development of flood routing procedures and the development of hydrologic design criteria for the Taylorsville, Bowie, Mize and Harleston Reservoirs. These major reservoirs are included in the early-action program for development of the water and related land resources in the basin.

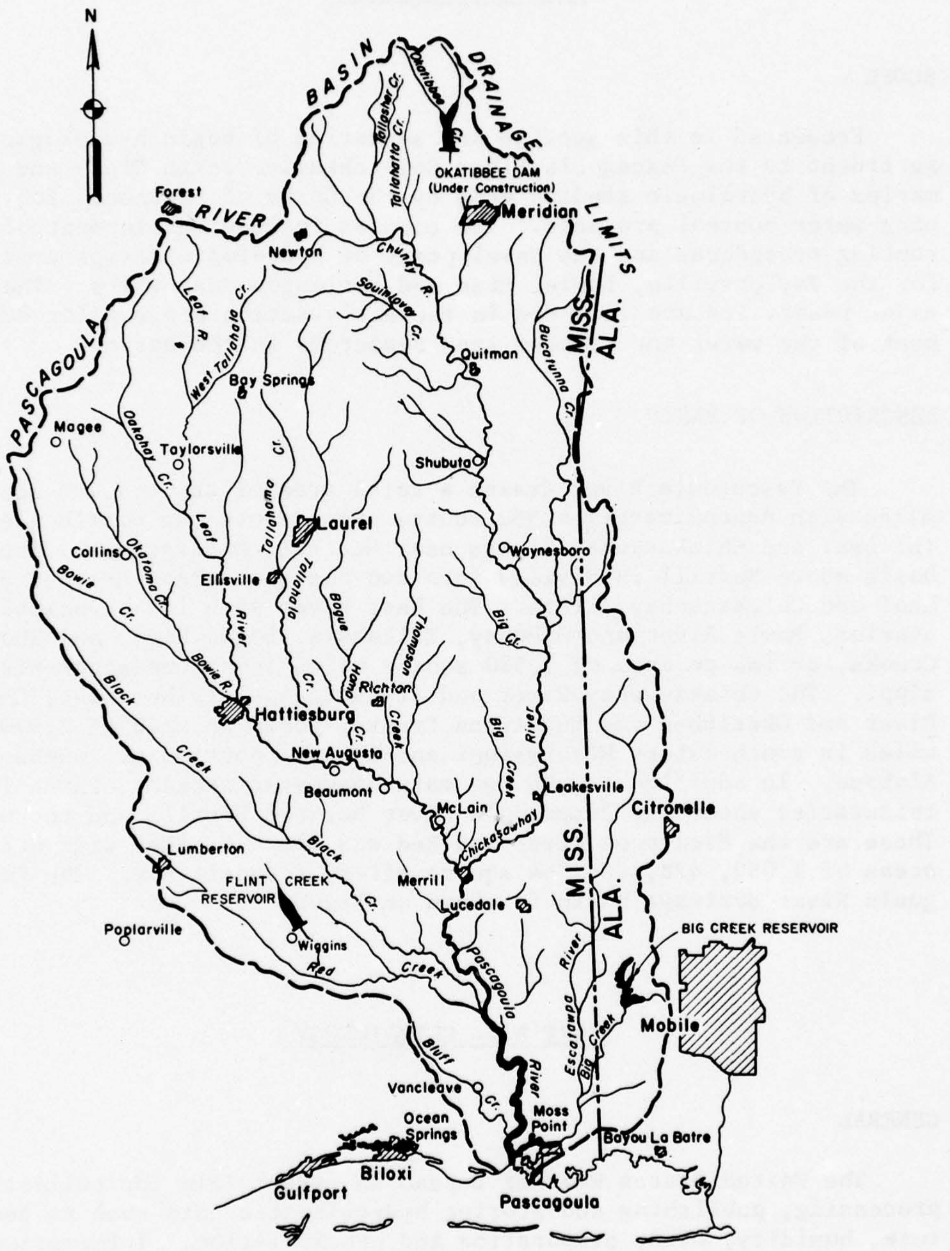
DESCRIPTION OF BASIN

The Pascagoula River drains a total area of about 9,700 square miles with approximately 6,550 square miles above the confluence of the Leaf and Chickasawhay Rivers near Merrill, Mississippi. The basin above Merrill is divided into two distinct areas drained by the Leaf and Chickasawhay Rivers. The Leaf River with its principal tributaries, Bowie River and Oakohay, Tallahala, Bogue Homo, and Thompson Creeks, drains an area of 3,580 square miles in southeastern Mississippi. The Chickasawhay River and its principal tributaries, Chunky River and Okatibbee and Bucatunna Creeks, drain an area of 2,970 square miles in southeastern Mississippi and a small portion of southwest Alabama. In addition to the two main headwater streams, three large tributaries enter the Pascagoula River between Merrill and the mouth. These are the Escatawpa River and Red and Black Creeks, with drainage areas of 1,060, 478, and 764 square miles, respectively. The Pascagoula River drainage basin is shown on Figure 1.

PART B — CLIMATOLOGY

GENERAL

The United States Weather Bureau is responsible for collecting, processing, publishing and storing hydroclimatic data such as temperature, humidity, wind, evaporation and precipitation. Information on these subjects presented below was obtained from Weather Bureau records and publications.



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

PASCAGOULA RIVER DRAINAGE BASIN

TEMPERATURE

The Pascagoula River Basin is in a region that usually has long, warm summers and short, mild winters. The normal annual temperature is about 60°, with normal monthly temperatures ranging from 51° in January to 82° in July. Extreme temperatures recorded in the basin are a low of -5° and a high of 109°. The frost-free season averages about 254 days per year. Temperature data for selected long-record stations in or near the basin are given in Table 1.

Table 1

Temperature data for selected stations

Station	Years of record	Extremes (°F)		Normals (°F)		
		Maximum	Minimum	January	July	Annual
Hattiesburg	75	106	-1	51.6	81.7	66.7
Laurel	64	106	7	50.1	81.7	66.1
Meridian	77	104	0	48.1	81.5	64.8
Mobile	97	104	-1	53.0	82.6	68.2

HUMIDITY

Relative humidity records are available for only two stations in or near the basin, the Weather Bureau first-order stations at Meridian and Mobile. The average relative humidity recorded at these stations for four times a day is shown in Table 2.

Table 2

Relative humidity for selected stations

Station	Relative humidity (%)			
	Midnight	6:00 am	Noon	6:00 pm
Meridian	87	91	55	65
Mobile	83	86	57	68

WIND

Wind records at the two first-order stations, Meridian and Mobile, are considered representative of the area. Prevailing winds at Meridian are generally from the south and average about 6 m.p.h.; at Mobile the winds are generally from the north and average about 10 m.p.h. High winds are rare, but occasionally, during the passage of cyclonic disturbances over or near the basin, there have been destructive local windstorms, some developing into tornadoes with winds of 100 m.p.h. or more. The extreme wind velocity recorded at Meridian, 50 m.p.h., occurred in April 1927 when a local windstorm associated with a cold front passed through the area. At Mobile the maximum recorded wind velocity of 98 m.p.h. occurred during the hurricane of October 1916. A few months earlier maximum winds of 97 m.p.h. were recorded during the passage of the July 1916 hurricane. Information gathered in connection with a study of hurricanes along the Gulf coast shows that 9 hurricanes passed over or near some portion of the Pascagoula River Basin during the period 1886-1964. As indicated by the records at Mobile and Meridian, the highest winds associated with these storms occur in the coastal section of the basin.

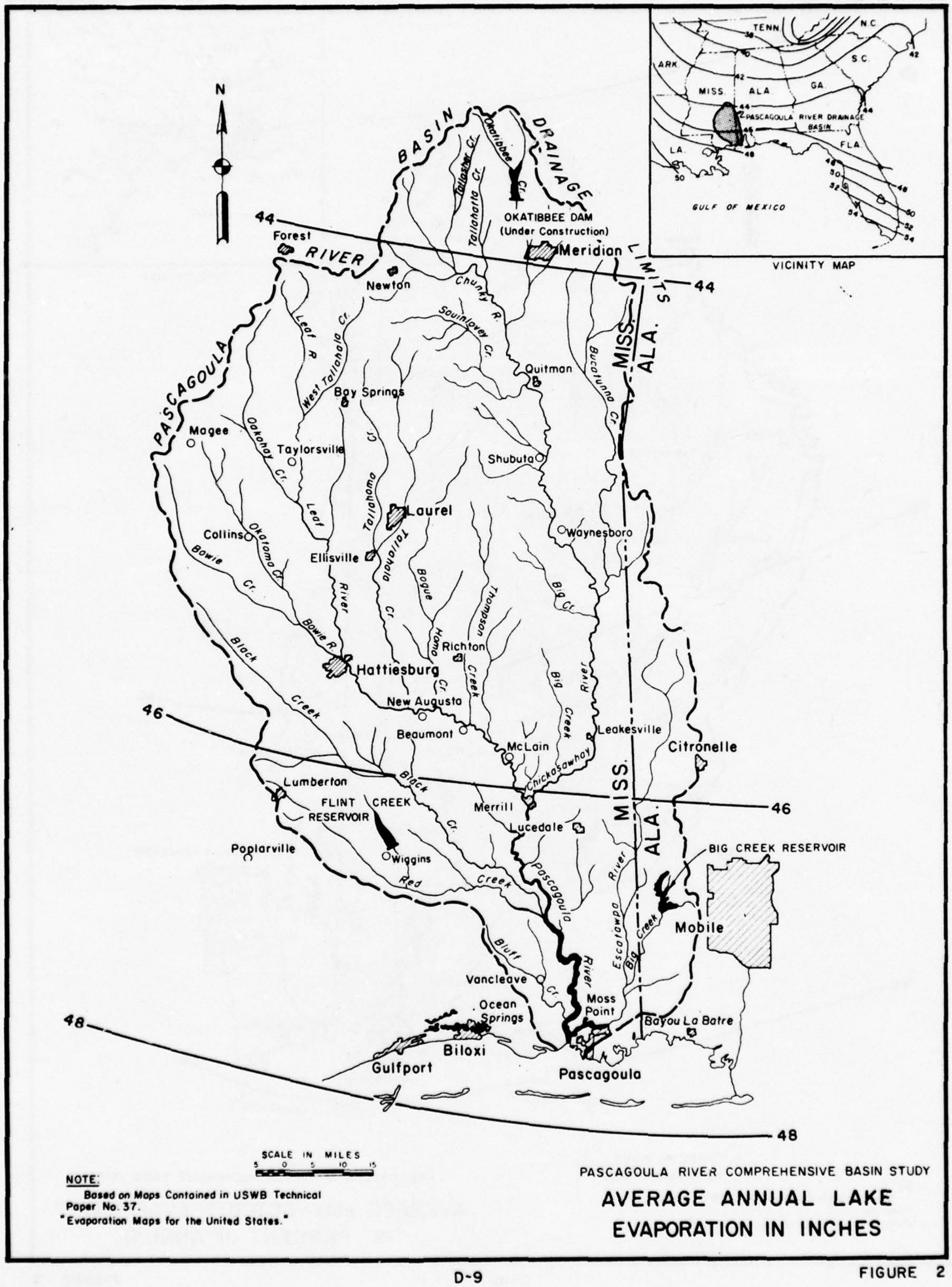
EVAPORATION

U. S. Weather Bureau Technical Paper No. 37, "Evaporation Maps for the United States", indicates that the average annual lake evaporation in the Pascagoula River Basin will vary from about 43 inches in the northern portion of the basin to about 48 inches near the mouth of the Pascagoula River. The variation is shown on Figure 2. From 66 to 70 percent of the average annual evaporation occurs during the months May-October, as shown on Figure 3.

PRECIPITATION

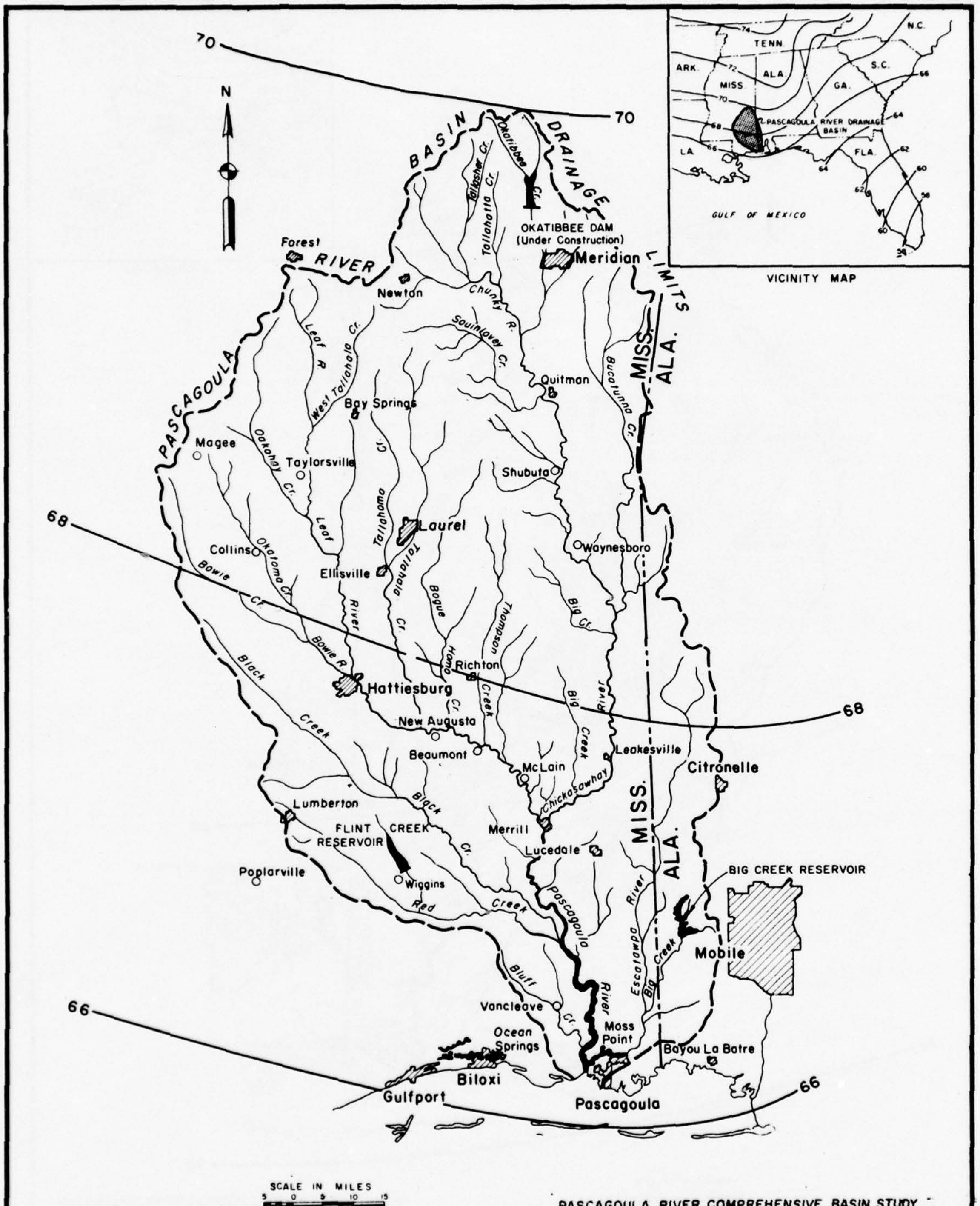
General. The Pascagoula River Basin lies in a region of heavy annual rainfall which is fairly well distributed throughout the year. There is some seasonal variation, with the heaviest rains usually occurring in the winter and spring and the lightest during the fall. The normal annual rainfall over the basin is 58.58 inches, of which 26 percent occurs in the winter, 29 percent in the spring, 27 percent in the summer and 18 percent in the fall. Normal monthly and annual rainfall at stations where normals have been established are given in Table 3. Moderate snowfall has occurred over the basin but seldom covers the ground for more than a few days at a time.

Records. As of 31 December 1965, there were 49 rainfall stations, most of them operated by the Weather Bureau, within or immediately adjacent to the Pascagoula River Basin. Records from these and 15



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

AVERAGE ANNUAL LAKE EVAPORATION IN INCHES



NOTE:
Based on Maps Contained in USWB Technical Paper No. 37.
"Evaporation Maps for the United States."

PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

AVERAGE MAY-OCTOBER EVAPORATION IN PERCENT OF ANNUAL

Table 3

Normal monthly and annual precipitation in inches
for the Pascagoula River Basin

Station	Precipitation in inches												
	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Collins	4.89	4.95	5.82	5.06	4.72	4.07	6.12	4.00	3.79	2.50	3.52	5.10	54.54
Enterprise	5.07	5.16	6.34	5.32	4.04	4.08	6.48	3.30	3.78	2.06	3.59	5.10	54.32
Hattiesburg	4.74	5.32	6.73	5.52	5.16	4.16	6.79	5.12	4.21	2.70	4.05	5.68	60.18
Hickory	5.41	5.19	6.50	5.62	4.02	3.52	6.24	3.69	3.58	2.47	3.93	5.66	53.83
Laurel	5.08	5.37	6.78	5.70	4.49	4.12	6.77	4.09	3.95	2.59	3.79	5.68	57.91
Leakesville	4.69	4.48	6.68	5.57	4.20	4.72	7.41	4.89	4.65	2.56	4.32	5.53	60.20
Meridian WBAP	4.64	5.09	6.32	5.33	3.91	4.07	6.22	3.54	3.33	2.22	3.10	5.31	53.13
Merrill	4.54	4.43	6.64	5.75	5.05	5.15	8.32	5.66	5.62	2.64	4.23	5.52	63.60
Mobile WBAP	4.64	4.59	7.23	6.36	4.88	6.23	9.67	6.44	6.25	3.03	3.35	5.46	68.13
Shubuta	4.92	5.36	6.93	5.44	4.49	4.25	7.77	3.47	4.14	2.21	3.86	5.59	58.43
Waynesboro	4.61	5.18	7.00	5.64	4.13	4.17	6.70	4.53	4.14	2.38	4.01	5.66	58.15
Basin Average	4.84	5.01	6.63	5.57	4.51	4.41	7.14	4.43	4.31	2.49	3.80	5.44	58.58

discontinued stations are available for varying periods. The longest continuous record is at Mobile and dates back to 1870. The locations of the rainfall stations are shown on Figure 4 and their periods of record and other pertinent data are given in Table 4.

Maximum recorded precipitation. Maximum amounts of precipitation recorded in the Pascagoula River Basin for 6-, 12- and 24-hour periods are shown on Figure 5.

Annual extremes. A study of rainfall records for the 75-year period 1890-1964 shows that the outstanding wet year in the basin was 1961 when the rainfall over the basin averaged 84.57 inches. The 5 wettest years of record are as follows:

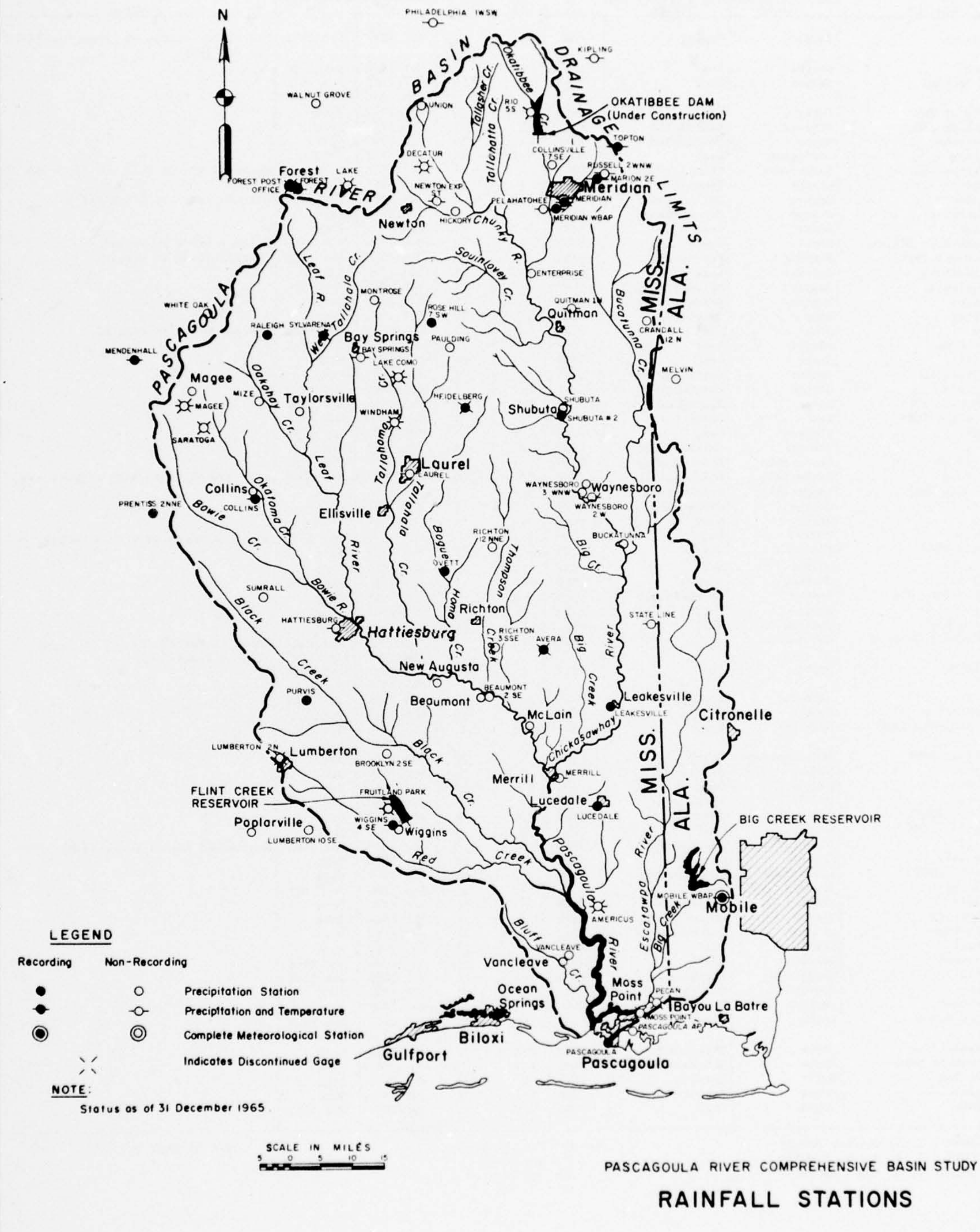
Year	Basin rainfall in inches
1961	84.57
1919	76.55
1900	75.95
1912	75.24
1929	74.42

The driest year in the basin was 1954 when the basin rainfall was only 38.10 inches. The 5 driest years of record are as follows:

Year	Basin rainfall in inches
1954	38.10
1963	38.94
1914	43.99
1924	44.07
1904	44.79

STORM RAINFALL CHARACTERISTICS

Flood-producing storms over the Pascagoula River Basin are usually of the frontal type, occurring in the winter and spring and lasting from 2 to 4 days. These storms usually cover large areas and produce most of the major inundations. Occasionally, during the summer, a severe general storm may accompany the inland passage of a tropical hurricane. Usually, however, summer storms are of the thunderstorm type with high intensities over small areas and cause only local flooding. With normal runoff conditions, from 5 to 6 inches of intense and general rainfall are required to produce widespread flooding, but on many of the minor tributaries 3 to 4 inches are sufficient to produce local floods.



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

RAINFALL STATIONS

FIGURE 4

Table 4

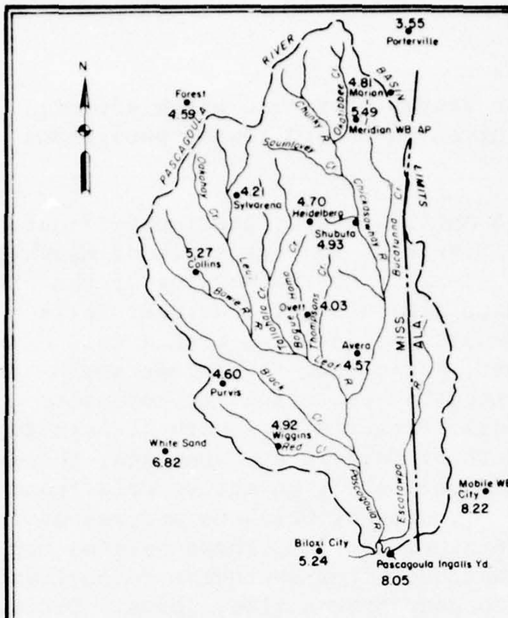
Rainfall stations in and adjacent to the Pascagoula River Basin

Station	Location: County	Location: Stream	Owner (1)	Type (2)	Period of record (3): Years	From	To	Remarks
Americus	Jackson	Pascagoula	USWB	N-T	3	Apr 1899	Feb 1901	Sta. known as Latonio from Aug 1900 to Feb 1901
Avera	Greene	Leaf	USWB	R	17	Mar 1940	Dec 1956	
Bay Springs	Jasper	Leaf	USWB	N-T	33	Mar 1912	Sep 1914	
						Nov 1936	Date	
Beaumont 2SE	Perry	Leaf	USWB	N	24	Feb 1942	Date	
Brooklyn 2SE	Forrest	Pascagoula	USFS	N	25	Jan 1941	Date	
Buckatunna	Wayne	Chickasawhay	USWB	N	26	Feb 1940	Date	
Collins	Covington	Leaf	USWB	R-T	54	Feb 1912	Date	
Collinsville	Lauderdale	Chickasawhay	USWB	N	28	Jul 1938	Date	Known as Rio 55 from Jul 38 to Mar 53.
Crandall 12N	Clarke	Tombigbee	USWB	N	26	Jun 1940	Date	
Decatur	Newton	Chickasawhay	USWB	N-T	6	Jan 1959	Feb 1964	Station inactive since 2-1-64
Enterprise	Clarke	Chickasawhay	USWB	N	75	Feb 1891	Date	
Forest	Scott	Leaf	USWB	R-T	33	Jan 1933	Date	
Forest Post Office	Scott	Leaf	USWB	R	2	Nov 1952	Mar 1953	Station moved to Forest
Fruitland Park	Forrest	Pascagoula	USWB	N-T	30	Jan 1917	May 1946	Station moved to Wiggins
Hattiesburg	Forrest	Leaf	USWB	N-T	75	Sep 1891	Date	
Heidelberg	Jasper	Chickasawhay	USWB	R	25	Feb 1940	Jun 1964	
Hickory	Newton	Chickasawhay	USWB	N	56	Jun 1910	Date	
Kipling	Kemper	Tombigbee	USWB	N-T	32	Oct 1934	Date	
Lake	Scott	Leaf	USWB	N-T	51	Apr 1882	Mar 1932	Station moved to Wiggins
Lake Como	Jasper	Leaf	USWB	N-T	10	Apr 1902	Oct 1911	
Laurel	Jones	Leaf	USWB	N-T	64	Feb 1902	Date	
Leakesville	Greene	Chickasawhay	USWB	R	72	Jan 1894	Date	
Lucedale	George	Pascagoula	USWB	N-T	1	Jul 1941	Oct 1941	
Lumberton 2N	Lamar	Pascagoula	USWB	N-T	7	Jul 1954	Dec 1960	
Lumberton 10SE	Pearl	Pearl	USWB	N	5	May 1950	May 1954	
Magee	Simpson	Leaf	USWB	N-T	5	Feb 1903	May 1907	
Melvin	Choctaw	Chickasawhay	USWB	N	24	Sep 1942	Date	
Marion 2E	Lauderdale	Chickasawhay	USSC	R-T	12	Sep 1940	Sep 1951	
Meridian	Lauderdale	Chickasawhay	USWB	R-T	60	Jul 1889	Oct 1948	Sta. consolidated with airport sta.
Meridian WBAP	Lauderdale	Chickasawhay	USWB	R-T	77	Jul 1889	Date	
Merrill	George	Pascagoula	USWB	N-T	61	Feb 1905	Date	
Mize	Smith	Leaf	USWB	N	26	May 1940	Date	
Mobile	Mobile	Gulf	USWB	R-T	83	Nov 1870	Apr 1953	Sta. consolidated with airport sta.
Mobile WBAP	Mobile	Gulf	USWB	R-T	32	Nov 1934	Date	
Montrose	Jasper	Leaf	USWB	N	26	May 1940	Date	
Moss Point	Jackson	Pascagoula	USWB	N-T	11	Nov 1889	May 1899	
Newton Exp. Sta.	Newton	Chickasawhay	USWB	N-T	18	Aug 1948	Date	
Ovett	Jones	Leaf	USWB	R	25	Mar 1941	Date	
Pascagoula	Jackson	Gulf	USWB	R	26	Feb 1940	Date	
Pascagoula Airport	Jackson	Gulf	USWB	N-T	32	Feb 1909	Dec 1921	Known as Pascagoula Jr. Hi from
						Jan 1947	Date	Jan 1947-Jun 1962
Paulding	Jasper	Leaf	USWB	N	36	Feb 1858	Nov 1869	
						May 1940	Date	
Pecan	Jackson	Pascagoula	USWB	N-T	7	Jul 1901	Jun 1908	
Pelahatchee	Rankin	Pearl	USWB	N-T	29	Nov 1936	Date	
Philadelphia 1WSW	Neshoba	Pearl	USWB	N-T	31	Jan 1870	Oct 1871	
						Sep 1936	Date	
Prentiss 2NNE	Jefferson Davis	Pearl	USWB	N	25	Apr 1940	Date	
Purvis	Lamar	Pascagoula	USWB	R	25	Aug 1940	Date	
Quitman 1N	Clarke	Leaf	USWB	N-T	12	Jan 1954	Date	
Raleigh	Smith	Leaf	USWB	R	2	Jun 1964	Date	
Richton 3SSE	Perry	Leaf	USWB	N-T	8	Oct 1958	Date	
Richton 12NNE	Wayne	Leaf	USFS	N	26	Jan 1940	Date	
Rio 5S	Lauderdale	Chickasawhay	USWB	N	16	Jul 1938	Mar 1953	Gage moved to Collinsville Mar 1953.
Rose Hill 7SW	Jasper	Leaf	USWB	R	2	Jun 1964	Date	
Russell 2WNW	Lauderdale	Chickasawhay	USSC	N-T	26	Oct 1940	Date	
Saratoga	Simpson	Leaf	USWB	N	1	Nov 1900	Oct 1901	
Shubuta	Clarke	Chickasawhay	USWB	N	60	Jan 1906	Date	
Shubuta #2	Clarke	Chickasawhay	USWB	R	26	Apr 1940	Date	
State Line	Greene	Chickasawhay	USWB	N-T	10	Mar 1956	Date	
Sumrall	Lamar	Leaf	USWB	N	26	May 1940	Date	
Sylvarena	Smith	Leaf	USWB	R	24	Mar 1941	Jun 1964	
Topton	Lauderdale	Chickasawhay	USWB	N-T	1	Apr 1897	Jul 1897	
Union	Newton	Chickasawhay	USWB	N	26	Feb 1940	Date	
Vancleave	Jackson	Pascagoula	USWB	N	26	May 1940	Date	
Walnut Grove	Leake	Pearl	USWB	N	39	Dec 1897	Jun 1907	
						Jul 1938	Date	
Waynesboro 2W	Wayne	Chickasawhay	USWB	N-T	12	Jan 1954	Date	
Waynesboro 3WNW	Wayne	Chickasawhay	USWB	N-T	77	Jan 1889	Date	
White Oak	Smith	Pearl	USWB	N	26	May 1940	Date	
Wiggins 4SE	Stone	Pascagoula	USWB	R-T	22	Jan 1944	Date	
Windham	Jones	Leaf	USWB	N-T	5	Apr 1897	Jul 1901	

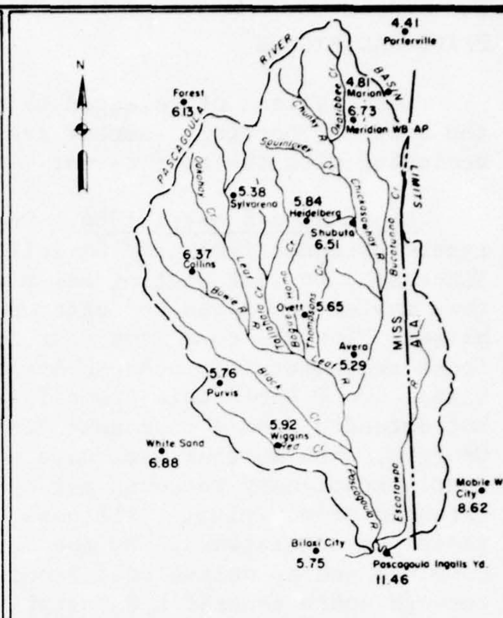
(1) USWB = U. S. Weather Bureau
USFS = U. S. Forest Service
USSC = U. S. Sugar Crops

(2) N = Non-recording
R = Recording
T = Temperature

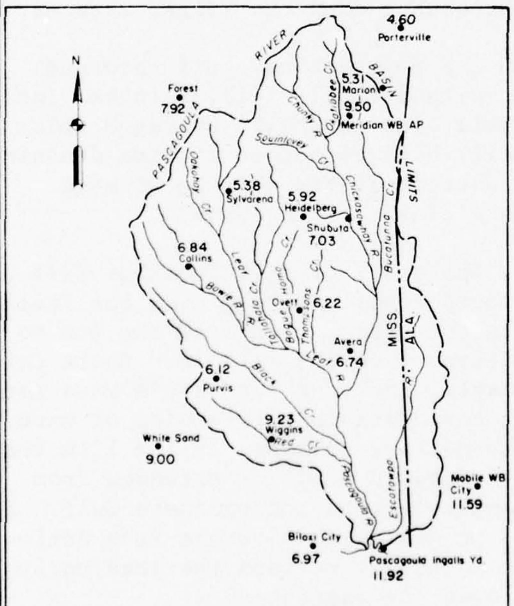
(3) Through Dec 1965



MAXIMUM RECORDED PRECIPITATION
Stations with 5 years or more of record
6 - HOUR



MAXIMUM RECORDED PRECIPITATION
Stations with 5 years or more of record
12 - HOUR



MAXIMUM RECORDED PRECIPITATION
Stations with 5 years or more of record
24 - HOUR

NOTE:
From USWB Technical Paper No. 15 "Maximum Station Precipitation for 1, 2, 3, 6, 12 and 24 Hours." Based on records through 1950.

PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

MAXIMUM RECORDED PRECIPITATION IN INCHES FOR 6, 12, AND 24 HOURS

PRINCIPAL STORMS

Descriptions of selected major storms of record which affected the basin or portions thereof are given in the following paragraphs beginning with the most recent.

Storm of 4-8 April 1964. On 4 April a nearly stationary frontal system extended from near Norfolk, Virginia, to just north of Memphis, Tennessee, to just west of Del Rio, Texas. By the morning of the 6th, this system had moved and extended as a warm front from near Tallahassee, Florida, to a wave near Evansville, Indiana, with a cold front southwest from near Shreveport, Louisiana, to extreme south Texas. On 7 April this frontal system had diminished in intensity but extended from a wave near Norfolk, Virginia, to south of Atlanta, Georgia, with another weak wave north of Nashville, Tennessee, thence nearly stationary to southwest Arkansas. Also, an active cold front extended from Chicago, Illinois, to southwest Oklahoma and was moving rapidly southeastward. By the morning of the 8th, these systems had combined and an active cold front extended from southwest Pennsylvania through south central Mississippi to near Brownsville, Texas. During the day this front continued a southeasterly movement.

Intense rains fell during the night of 5-6 April, in a narrow band extending from 10 miles south of Bay Springs through Enterprise, and northeast into Alabama near Kewanee. A second rain of 2 to 4 inches fell in the Laurel-Shubuta area on the night of 7-8 April and caused a buildup in the floods progressing down the larger streams.

In the Pascagoula River Basin the heaviest rainfall recorded occurred at Crandall, Mississippi, with a total of 13.35 inches for the period 4-8 April. Total rainfall over the basin averaged about 7 inches. This rain produced unusually high floods on streams draining up to 500 square miles. The most extreme floods were on streams originating near Laurel and in the vicinity of Meridian.

Storm of 6-18 December 1961. The storm of 6-18 December 1961 resulted from a slow moving surface cold front crossing over the Pascagoula River Basin, causing moderate but steady rain from the 6th to 11th. The front became almost stationary on the 11th from South Carolina southwestward to the Texas coast. Early on the 12th a wave formed along the Louisiana coast, causing considerable overrunning of warm, moist air from the Gulf over the colder air inland. By the 13th the original cold front had moved southeastward until it extended from the Atlantic across the Florida peninsula into the northern Gulf. It remained across the northern Gulf, producing small-scale wave action until a second cold front from the northwest crossed the area early on the 18th and brought drier air over the watershed.

In the Pascagoula River Basin the heaviest rainfall recorded occurred at Beaumont, Mississippi, with a total of 19.57 inches for the period 6-18 December. Total rainfall over the basin averaged about 12 inches. This rain produced high floods on drainage areas from 100 to 400 square miles in the upper portion of the basin. Floods along the larger streams were not particularly outstanding although the lower part of the drainage basin lay in the area of heavy rainfall.

Storm of 17-25 February 1961. The storm of 17-25 February 1961 was the result of quasi-stationary fronts and a maritime tropical air mass. The rains began on the 17th in a strong southerly flow as a cold front moved into the lower Mississippi Valley, becoming weak and diffused. On the 18th, a second and stronger cold front oriented northeast-southwest moved into the Gulf States, reaching central Alabama on the morning of the 19th. The front became stationary from Alabama and Mississippi southwestward along the Texas coast, while the northern portion of the front moved to the east so that by the 20th a stationary front extended from South Carolina westward across southern Alabama and Mississippi to the Texas coast. On the 20th a wave developed on the front off the Texas coast. This wave moved northeastward as a warm front, yielding from 4 to 8 inches of rain in north-central Alabama in a 24-hour period. By the morning of the 22nd the wave had developed slightly and moved to western Kentucky, with a cold front across southern Georgia and Alabama. The cold front moved into central Georgia and became diffused the following day. A sharp cold front oriented northeast-southwest moved rapidly into the Gulf States on the 24th, while a warm front developed and extended from Georgia westward across south Alabama and Mississippi to the Texas coast. As the cold front reached the Texas coast a wave developed and, deepening, moved rapidly northeastward. The heaviest rains of the period occurred with this system.

In the Pascagoula River Basin the heaviest rainfall recorded occurred at Purvis, Mississippi, with a total of 19.20 inches for the period 17-25 February. Total rainfall over the basin averaged about 13 inches. Flooding was severe throughout the basin except in the easternmost portion and record or near record stages occurred on most of the streams. Flood damage to municipalities, roads, and agriculture was extensive.

Storm of 5-9 April 1938. The storm of 5-9 April 1938 was accompanied by a low pressure area which entered the United States from Canada through North Dakota, moved southward to southern Texas and then northeastward across the southern United States to the Atlantic Ocean. The heaviest rains occurred over central Alabama and large portions of Mississippi and Louisiana and produced severe general floods in these areas. The most intense center of precipitation was

at Lock 2, Alabama, on the Tombigbee River, where a total of 13.6 inches of rain was recorded.

In the Pascagoula River Basin the heaviest rainfall recorded occurred at Enterprise, Mississippi, with a total of 10.9 inches for the period 5-9 April 1938. Total rainfall over the basin averaged about 6 inches. The resulting flood was severe in the Chickasawhay River portion of the basin. Stages were not record-breaking but did approach within one or two feet of the record stages in some localities.

Storm of 6-10 December 1919. The storm of 6-10 December 1919 was caused by meteorological conditions which were not particularly remarkable but the sequence in which they developed was the controlling factor. A cyclonic system moved inland across California on 4 December. On the mornings of 5, 6 and 7 December, it was centered over Utah, Oklahoma and New York successively. A weak cold front was associated with it on the morning of the 7th and extended across Pennsylvania, Maryland, Virginia, and western North Carolina, then became quasi-stationary over northern Georgia, central Alabama, Mississippi and Louisiana. The front lay in that position the evening of the 9th. An anticyclonic system persisted during the period just off the Atlantic coast and the circulation set up thereby brought a convergent flow of heavily moisture-laden air from the Gulf region directly over the area. Overrunning and wave development over the initially shallow front brought only moderate precipitation during 6-8 December, but a fresh mass of continental polar air thrust southward on the afternoon of the 8th and on the 9th. The intense convergence about the new development changed the situation to one in which flood-producing rainfall was experienced on 8-9 December, diminishing on the 10th when the front passed eastward. The area of heaviest precipitation extended across southeastern Mississippi, central Alabama and northern Georgia. The center of greatest rainfall was at Norcross, Georgia, with a total of 12.9 inches.

In the Pascagoula River Basin the heaviest rainfall recorded occurred at Hickory, Mississippi, with a total of 11.4 inches for the period 6-10 December. Total rainfall over the basin averaged about 6 inches. The flood from this rainfall was particularly extreme in the Tallahala Creek area and caused the highest known stage at Laurel. Severe flooding also occurred in the Meridian and Hattiesburg areas, causing considerable damage.

Storm of 5-10 July 1916. The storm of 5-10 July 1916 resulted from a tropical hurricane which formed in the Caribbean Sea and moved northwest across the Gulf of Mexico to enter the United States east of the mouth of the Mississippi River on the evening of 5 July. The disturbance continued inland across western Mississippi, turned

eastward on the 7th and from the 8th to the 10th moved northeastward across Alabama. After the passage of the hurricane, conditions remained unstable and the rains continued through 23 July.

In the Pascagoula River Basin the heaviest rainfall recorded occurred at Leakesville, Mississippi, with a total of 20.30 inches for the period 5-10 July. Total rainfall over the basin averaged about 13 inches and produced severe floods in the lower portion. The stage at Merrill was the second highest in history. Stages on the Chickasawhay and Leaf Rivers were high but have been exceeded by several other floods.

Storm of 14-18 April 1900. The storm of 14-18 April 1900 resulted from a low pressure area and a cold front. On the 14th the low was centered over the Texas Panhandle and began moving northeastward. A cold front moved into the eastern United States on the morning of the 15th and became almost stationary. The combination of the two fronts caused unstable conditions and heavy rainfall over the Southeast.

In the Pascagoula River Basin the heaviest rainfall recorded occurred at Windham, Mississippi, with a total of 12.84 inches for the period 14-18 April. Total rainfall over the basin averaged about 8 inches. This rain caused one of the greatest known floods in the Pascagoula River Basin, with record stages occurring on many of the streams.

PART C — RUNOFF AND STREAM FLOW DATA

RECORDS

Streamflow records for the Pascagoula River Basin are relatively short. The earliest river records, for stages only, were obtained by the Weather Bureau which established a few stations in 1904. The U. S. Geological Survey began systematic flow data collection in the basin in the late 1930's. The Corps of Engineers also began data collection about the same time but discontinued after a few years. Data used in this report were therefore taken from records of gage height and discharge collected by the U. S. Geological Survey and supplemented with those obtained by the Weather Bureau and Corps of Engineers. These records have been obtained at 153 different sites in the basin. Of these sites, 22 were maintained over a period of years to obtain a continuous record of daily flow. As of 30 September 1965, there were 65 stations in service with continuous records of daily flow being obtained at 19 sites, annual peaks at 19 sites

and low flows at 27 sites. The records from these stations, in addition to several which have been discontinued, provide sufficient data for a general analysis of the basin flood problems and a determination of water use potential. If the proposed Tallahala, Taylorsville, Bowie, Mize and Harleston Reservoirs are authorized, gaging stations would be established at the damsites to obtain additional information for detailed planning.

Table 5 gives the location, operating agency, period of record, and other information for the 65 stations. As a means of identification and reference, the U. S. Geological Survey national numbers of the stations have been used. The prefix "2B", which designates the area, has been omitted for simplicity. The locations of the stations are shown on Figure 6.

DISTRIBUTION OF RUNOFF

General. A study prepared by the U. S. Geological Survey indicates a wide variation in average annual local runoff from the upper to the lower part of the basin. This variation is shown on Figure 7. Runoff from the basin as a whole averages about 23 inches, or 39 percent of the annual rainfall. The three largest tributaries, the Leaf, Chickasawhay, and Escatawpa Rivers, have average annual runoffs of about 21 inches, 19 inches, and 30 inches, respectively. Table 6 lists the average annual runoff as well as the variability during extreme years for selected gaging stations in the basin.

The runoff in the basin varies widely during the year, being high in the winter and spring months and low in late summer and early fall. About 59 percent of the annual runoff occurs during the four-month period from January through April. Minimum runoff occurs during the three-month period from August through October and averages only about 10 percent of the annual runoff. Table 7 lists the average monthly runoff distribution for selected gaging stations in the basin.

Mean discharges. The average flows of the streams in the basin listed in Table 5 vary from 1.09 to 2.17 c.f.s. per square mile. Based on records for the Pascagoula River at Merrill during the period of record 1930-1965, the average discharge for the approximately 6,600 square mile area drained by the Pascagoula River system at this point is estimated to be about 9,500 c.f.s. or 1.44 c.f.s. per square mile.

The mean monthly flows were estimated for 4 areas in the basin for use in power studies. A description of the method used to estimate the mean monthly flows is given in Section 5 of this appendix. Tabulations of the flows in cubic feet per second per square mile are shown in Tables 35 through 38 in that section.

Table 5

Active gaging stations in the Pascagoula River Basin
(As of 30 September 1965)

National station No.	Stream and station	Miles above mouth	Drainage area sq.mi.	Agency observing	*Type of records	Period of record: From	Period of record: To	Total years	Gage zero m.s.l.	Extreme stages and discharges of record: Maximum: Date	Maximum: Stage ft.	Maximum: Disch. c.f.s.	Minimum: Date	Minimum: Stage ft.	Minimum: Disch. c.f.s.	Average disch. c.f.s.	Pre-record floods: Date	Pre-record floods: Stage ft.	Pre-record floods: Dischg. c.f.s.
4711	Leaf River Raleigh	144.25	143	USGS	AP, LF	1940 1957	1943 1965	11[a]	--	21 Feb 61	** 309.48	14,500	25 Oct 54	--	0.36	--	--	--	--
4712.5	Leaf River Taylorsville	126.60	217[b]	USGS	LF	1957, 60, 64	1965	4	--	--	--	--	17 Oct 63	--	18.2	--	--	--	--
4719	Oakohay Creek Hot Coffee	1/	270[b]	USGS	LF	1965	--	1	--	--	--	--	27 Sep 65	--	56.4	--	--	--	--
4720	Leaf River Collins	115.30	752	USGS	R	Sep 1938	Sep 1965	26	197.48	23 Feb 61	31.65	48,500	20-30 Aug 1957	3.70	55	1,038	Apr 1856 Apr 1900	33.0 32.0	-- --
4721	Big Creek Laurel	3.9[c]	100[b]	USGS	LF	1943 1951,1954 1964	1944 1960 1965	7	--	--	--	--	18 Sep 56	--	12.3	--	--	--	--
4723.5	Leaf River Ellisville	101.60	910[b]	USGS	LF	1954-56 60, 64	1965	6	--	--	--	--	18 Sep 56	--	96.4	--	--	--	--
4723.7	Leaf River Moselle	2/	1,073	USGS	LF	1965	--	1	--	--	--	--	25 May 65	--	304	--	--	--	--
4725	Bowie Creek Hattiesburg	15.20	304	USGS	R	Sep 1938	Sep 1965	27	160.04	22 Feb 61	26.54	34,800	29 Aug 57	2.58	83	445	--	--	--
4727	Okatoma Cr.Trib. Mt. Olive	3/	.41	USGS	AP	1965	--	1	--	12 Feb 65	4.69	163	--	--	--	--	--	--	--
4728.5	Okatoma Creek Sanford	4/	240[b]	USGS	LF	1965	--	1	--	--	--	--	16 Jul 65	--	124	--	--	--	--
4729.4	Bowie Creek Hattiesburg	5/	656	USGS	LF	1964	1965	2	--	--	--	--	17 Oct 63	--	190	--	--	--	--
4730	Leaf River Hattiesburg	72.30	1,760	USGS	R	Sep 1938	Sep 1965	27	118.23	23 Feb 61	31.53	72,200	22 Oct 63 27&28 Aug 57	4.02	318	2,595	Apr 1900	33.6	--
4733.2	Leaf River McCallum	58.85	1,850[b]	USGS	LF	1964	1965	2	--	--	--	--	16 Oct 63	--	368	--	--	--	--
4734.8	Tallahattah Creek Waldrup	1.2[c]	30.7	USGS	R	Jan 1965	Sep 1965	--	265.25	23 Jan 65	14.14	892	24 Jul 65	--	1.3	--	18 Feb 61 6 Apr 64	17.07 16.30	-- --
4735	Tallahala Creek Laurel	6/	233	USGS	R	Sep 1938	Sep 1965	27	201.37	7 Apr 64	23.13	21,100	3 Nov 52 1 Oct 63 31 Oct 63 1 Nov 63	1.21	1.8	328	9 Dec 19 Apr 1900 Apr 38	26.0 24.0 20.7	-- -- --
4741	Tallahoma Creek Laurel	8.9[c]	d	USGS	LF	1953 1959 1964	1957 1960 1965	9	--	--	--	--	17 Oct 63	--	0.40	--	--	--	--
4745	Tallahala Creek Runnelstown	9.0[c]	612	USGS	R	Oct 1939	Sep 1965	26	109.58	24 Feb 61	24.87	32,800	31 Oct 63	0.16	29	901	Apr 1900 Dec 1919	30.5 26.5	--

Table 5 (cont'd)

Active gaging stations in the Pascagoula River Basin
(As of 30 September 1965)

National station No.	Stream and station	Miles above mouth	Drainage area sq.mi.	Agency observing	*Type of records	Period of record: From	Period of record: To	Total years	Gage zero m.s.l	Extreme stages and discharges of record, Maximum: Date	Maximum: Stage ft.	Maximum: Dischg. c.f.s.	Minimum: Date	Minimum: Stage ft.	Minimum: Dischg. c.f.s.	Average dischg. c.f.s.	Pre-record floods: Date	Pre-record floods: Stage ft.	Pre-record floods: Dischg. c.f.s.
4745.4	Tallahala Creek Mahned	7/	640[b]	USGS	LF	1964	1965	2	--	--	--	--	16 Oct 63	--	47.0	--	--	--	--
4746	Bogue Homo Richton	15.7[c]	270[b]	USGS	LF	1944,1955 1965	1956	4	--	--	--	--	28 Nov 56	--	7.75	--	--	--	--
4746.5	Buck Creek Runnelstown	2.5[c]	19.1	USGS	AP	1951	1965	14	Assumed datum	18 Feb 61	** 94.89	3,900	--	--	--	--	--	--	--
4746.7	Bogue Homo New Augusta	8/	d	USGS	LF	1964	1965	2	--	--	--	--	16 Oct 63	--	17.3	--	--	--	--
4748	Thompson Creek Richton	16.1	186[b]	USGS	LF	1943,51, 53 1964	1957 1965	9	--	--	--	--	16 Oct 63	--	3.06	--	--	--	--
4748.2	Thompson Creek Hintonville	9/	d	USGS	LF	1964	1965	2	--	--	--	--	16 Oct 63	--	7.96	--	--	--	--
4749.6	Gaines Creek Beaumont	10/	d	USGS	LF	1964	1965	2	--	--	--	--	14 Oct 63	--	0.15	--	--	--	--
4749.9	Atkinson Creek McLain	11/	d	USGS	LF	1964	1965	2	--	--	--	--	14 Oct 63	--	1.15	--	--	--	--
4750	Leaf River McLain	14.60	3,510[b]	USGS	R	Oct 1939	Sep 1965	26	42.15	26 Feb 61	31.64	128,000	22 Oct 63 7 Sep 57	-- 1.88	478 --	5,319	Apr 1900	32.0	--
4750.5	Waterfall Br. McLain	0.7[c]	.65	USGS	AP, LF	1955	1965	11[e]	--	1 Jun 59	10.99	764	At times	--	No flow	--	--	--	--
4752.2	Little Rock Cr. Trib. Little Rock	12/	.22	USGS	AP	1965	--	1	--	12 Feb 65	3.51	40	--	--	--	--	--	--	--
4753.5	Tarlow Creek Newton	13/	15.9	USGS	AP	1952	1965	14	--	31 Mar 62	18.38	4,600	--	--	--	--	--	--	--
4755	Chunky River Chunky	18.20	368	USGS	R	Aug 1938	Sep 1965	27	269.00	22 Feb 61	25.58	30,800	28-30 Sep 54 21,22 Oct 63	-- 2.08	1.6 --	462 --	 --	 --	 --
4760	Okatibbee Creek Meridian	21.47	239	USGS	R,AP,LF	Aug 1938 Jun 1961	Sep 1950 Sep 1965	16[f]	269.43	22 Feb 61	26.14	27,000	4 Nov, 14 Dec 63	--	.5	339	Apr 1938 15 Mar 29	25.3 25.0	-- --
4765	Sowashee Creek Meridian	8.0[c]	51.9	USGS	R	Oct 1950	Sep 1965	15	305.95	6 Apr 64	23.09	9,530	4 Oct 54	--	.2	56.8	Feb 1936 31 Mar 49	29.5 26.6	-- --
4770	Chickasawhay R. Enterprise	163.10	913	USGS	R	Aug 1938	Sep 1965	27	212.62	23 Feb 61	37.94	61,700	13-20,23 24 Oct 52 25-30 Sep 54; 22-25 Oct 63	1.05 -- --	 18	1,169	Apr 1900 -- --	37.2 -- --	-- -- --

Table 5 (cont'd)

Active gaging stations in the Pascagoula River Basin
(As of 30 September 1965)

National station No.	Stream and station	Miles above mouth	Drainage area sq.mi.	Agency observing	*Type of records	Period of record From	Period of record To	Total years	Gage zero m.s.l.	Maximum Date	Maximum Stage ft.	Maximum Dischg. c.f.s.	Minimum Date	Minimum Stage ft.	Minimum Dischg. c.f.s.	Average dischg. c.f.s.	Pre-record floods Date	Pre-record floods Stage ft.	Pre-record floods Dischg. c.f.s.
4770.5	Souinlovey Creek Baxter	14/	1.08	USGS	AP	1965	--	1	--	12 Feb 65	8.13	446	--	--	--	--	--	--	--
4770.9	Powers Creek Rose Hill	15/	.45	USGS	AP	1965	--	1	--	11 Dec 64	7.09	355	--	--	--	--	--	--	--
4771	Souinlovey Creek Pachuta	20.0	174	USGS	AP,LF	1957	1965	9^g	--	7 Apr 64	** 256.30	20,000	19 Oct 56	--	2.53	--	--	--	--
4771.5	Pachuta Creek Pachuta	4.7	23^b	USGS	AP,LF	1952	1965	14^h	--	6 Apr 64	** 270.91	7,200	18 Oct 54	--	1.34	--	--	--	--
4771.8	Souinlovey Creek Quitman	$.10^c$	d	USGS	LF	1965	--	1	--	--	--	--	5 Jun 65	--	13.9	--	--	--	--
4773.3	Shubuta Creek Shubuta	5.0^c	95	USGS	AP, LF	1964	1965	2	--	6 Apr 64	22.22	15,000	17 Oct 63	--	6.38	--	--	--	--
4773.5	Chickasawhay R. Shubuta	118.0	1,460	USGS	LF	1954 1964	1965	3	--	--	--	--	17 Oct 63	--	58.2	--	--	--	--
4773.6	Eucutta Creek Shubuta	16/	d	USGS	LF	1964	1965	2	--	--	--	--	18 Oct 63	--	8.94	--	--	--	--
4774.9	Yellow Creek Waynesboro	17/	d	USGS	LF	1964	1965	2	--	--	--	--	17 Oct 63	--	15.9	--	--	--	--
4775	Chickasawhay R. Waynesboro	95.50	1,660	USGS	R,AP,LF	1938 1951 1964	1950 1959 1965	23^i	119.91	24 Jan 47	39.00	26,000	28 Aug 43	2.48	149	2,575	Apr 1900 11 Apr 38	50.0 47.1	73,000 53,100
4776	Patton Creek Waynesboro	2.0^c	10.0^b	USGS	AP, LF	1956 1964	1960 1965	7^j	--	--	--	--	18 Oct 56	--	1.86	--	--	--	--
4780	Bucatunna Creek Denham	18/	468	USGS	R, LF	Jan 1939 1953	Sep 1949 1958	17^k	134.49	27 Apr 44	28.00	16,400	25&28 Oct 1941 11-13 Oct 1943	-- 0.35	22.0	789 --	Apr 1900 --	34.0 --	-- --
4780.2	Big Red Creek Buckatunna	19/	d	USGS	LF	1964	1965	2	--	--	--	--	15 Oct 63	--	6.62	--	--	--	--
4780.3	Bucatunna Creek Buckatunna	2.4^c	600^b	USGS	LF	1964	1965	--	--	--	--	--	15 Oct 63	--	31.2	--	--	--	--
4781	Big Creek Clara	17.6^c	46^b	USGS	LF	1943-44,1951, 1959-60	1953-57 1964-65	11	--	--	--	--	17 Oct 63	--	2.38	--	--	--	--
4781.4	Big Creek Buckatunna	20/	d	USGS	LF	1964	1965	2	--	--	--	--	15 Oct 63	--	5.79	--	--	--	--
4785	Chickasawhay R. Leakesville	29.10	$2,680^b$	USGS	R	Sep 1938	Sep 1965	27	51.13	28 Feb 61	33.52	73,600	30-31 Oct 63	--	160	3,691	Apr 1900 12 Apr 38	38.0 34.12	 68,800

Table 5 (cont'd)

Active gaging stations in the Pascagoula River Basin
(As of 30 September 1965)

National station No.	Stream and station	Miles above mouth	Drainage area sq.mi.	Agency observing	*Type of records	Period of record From	Period of record To	Total years	Gage zero m.s.l.	Extreme stages and discharges of record: Maximum Date	Maximum Stage ft.	Maximum Dischg. c.f.s.	Minimum Date	Minimum Stage ft.	Minimum Dischg. c.f.s.	Average dischg. c.f.s.	Pre-record floods Date	Pre-record floods Stage ft.	Pre-record floods Dischg. c.f.s.
4787	Big Creek Leakesville	7.0[c]	140	USGS	LF	1943-44,1951 1959-60	1953-55 1964-65	10	--	--	--	--	14 Oct 63	--	6.37	--	--	--	--
4790	Pascagoula River Merrill	82.17	6,600[b]	USGS	R	Oct 1930	Sep 1965	35	26.25	27 Feb 61	30.66	178,000	3 Nov 36 21-26 Oct 1963	-- 1.92	696 --	-- 9,529	Apr 1900 9 Jul 1916	32.5 31.0	-- --
4790.4	Big Creek Lucedale	12.4[c]	22.0	USGS	AP, LF	1952	1965	14[l]	--	1 Jun 59	** 95.77	7,000	20 Oct 54	--	4.70	--	--	--	--
4791	Black Creek Purvis	21/	154	USGS	AP	1957	1965	9	--	18 Feb 61	28.20	15,700	--	--	--	--	--	--	--
4791.3	Black Creek Brooklyn	64.1[c]	352	USGS	LF	1942 1954 1964	1945 1959 1965	7	--	--	--	--	16 Oct 63	--	45.9	--	--	--	--
4791.4	Wells Creek Brooklyn	22/	22.3	USGS	AP, LF	1951	1965	15[m]	--	1 Jun 59	** 98.31	6,000	18 Sep 56	--	1.57	--	--	--	--
4791.65	Mosquito Branch Benndale	0.3[c]	.22	USGS	AP, LF	1955	1965	11[n]	--	12 Apr 55	8.26	314	23 Jun 60	--	0	--	--	--	--
4791.7	Big Black Cr. Benndale	10.5[c]	760[b]	USGS	AP, LF	1958	1965	8[o]	--	12 Dec 61	40.19	24,500	11 Oct 63	--	101	--	--	--	--
4791.8	Red Creek Lumberton	67.0[c]	15.6	USGS	AP, LF	1951	1965	15[p]	Assumed datum	18 Feb 61 10 Dec 61	** 98.70	3,500	15 Oct 63	--	0.08	--	--	--	--
4791.9	Red Creek Wiggins	48.4	168	USGS	AP, LF	1952	1965	14[q]	--	10 Dec 61	** 148.82	17,000	23 Oct 53	--	22.4	--	--	--	--
4792	Flint Creek Wiggins	5.5[c]	24.8	USGS	R, AP	1953 Aug 1957	1954 Sep 1965	10[r]	132.05	27 Apr 64	16.39	3,670	28,29 Aug 57 & 9 Oct 63	-- 2.82	-- --	53.9	15 Nov 48	16.0	--
4793	Red Creek Vestry	23/	416	USGS	R	Jul 1958	Sep 1965	7	20.10	12 Dec 61	--	21,500	22 Oct 63	--	88	851	--	--	--
4795	Escatawpa River Wilmer	24/	506	USGS	R	Aug 1945	Sep 1965	20	55.27	2 Jun 59	24.66	30,000	2-4 Sep 54	--	37	979	--	--	--
4796	Escatawpa River Hurley	25/	639	USGS	R,AP,LF	Jul 1958 1961	Dec 1960 1965	7[s]	15.14	14 Dec 61	15.84	19,800	11 Oct 63	--	124	--	--	--	--
4801.5	Franklin Creek Grand Bay	3.1[c]	16.4	USGS	AP, LF	1959	1965	7[t]	--	12 Apr 61	16.54	2,750	12 Jun 63	--	17.4	--	--	--	--

* AP - Annual peaks, LF = Low flows, R = Recording.
** Elevation in mean sea level determined from using reference point.
1/ State Highway 37 Bridge, at Hot Coffee.
2/ Interstate Highway 59 Bridge, 2 miles west of Moselle.
3/ State Highway 523, double box culvert 6' x 4', 0.3 miles east of Mt. Olive.
4/ State Highway 598 Bridge, 1/4 mile west of Sanford.

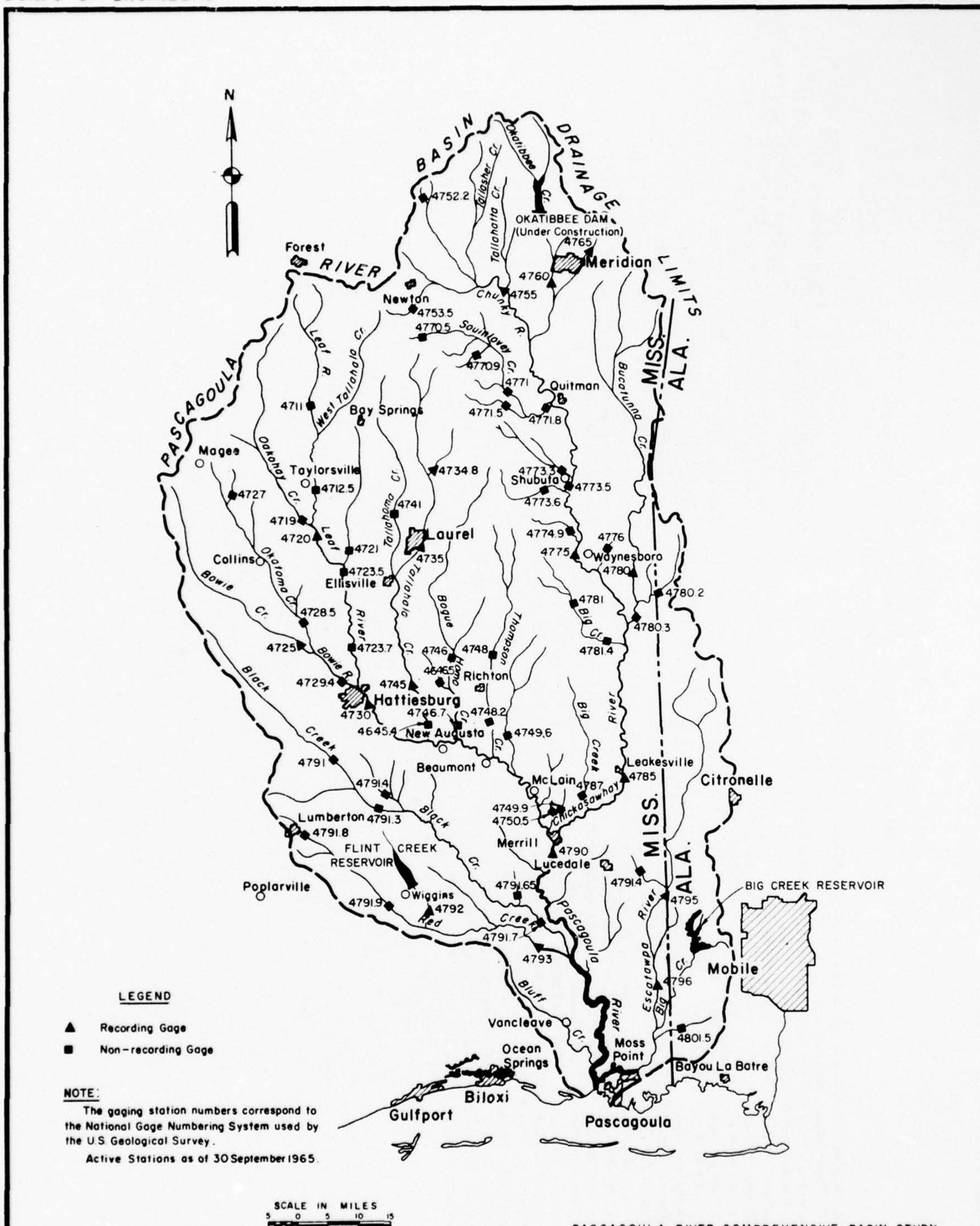
a. Low flow 1943, 1951-52, 1955-57, 1960.
b. Approximately.
c. USGS mileage.
d. Not determined.
e. Low flow 1956-57 and 1960.

Table 5 (cont'd)

Active gaging stations in the Pascagoula River Basin
(As of 30 September 1965

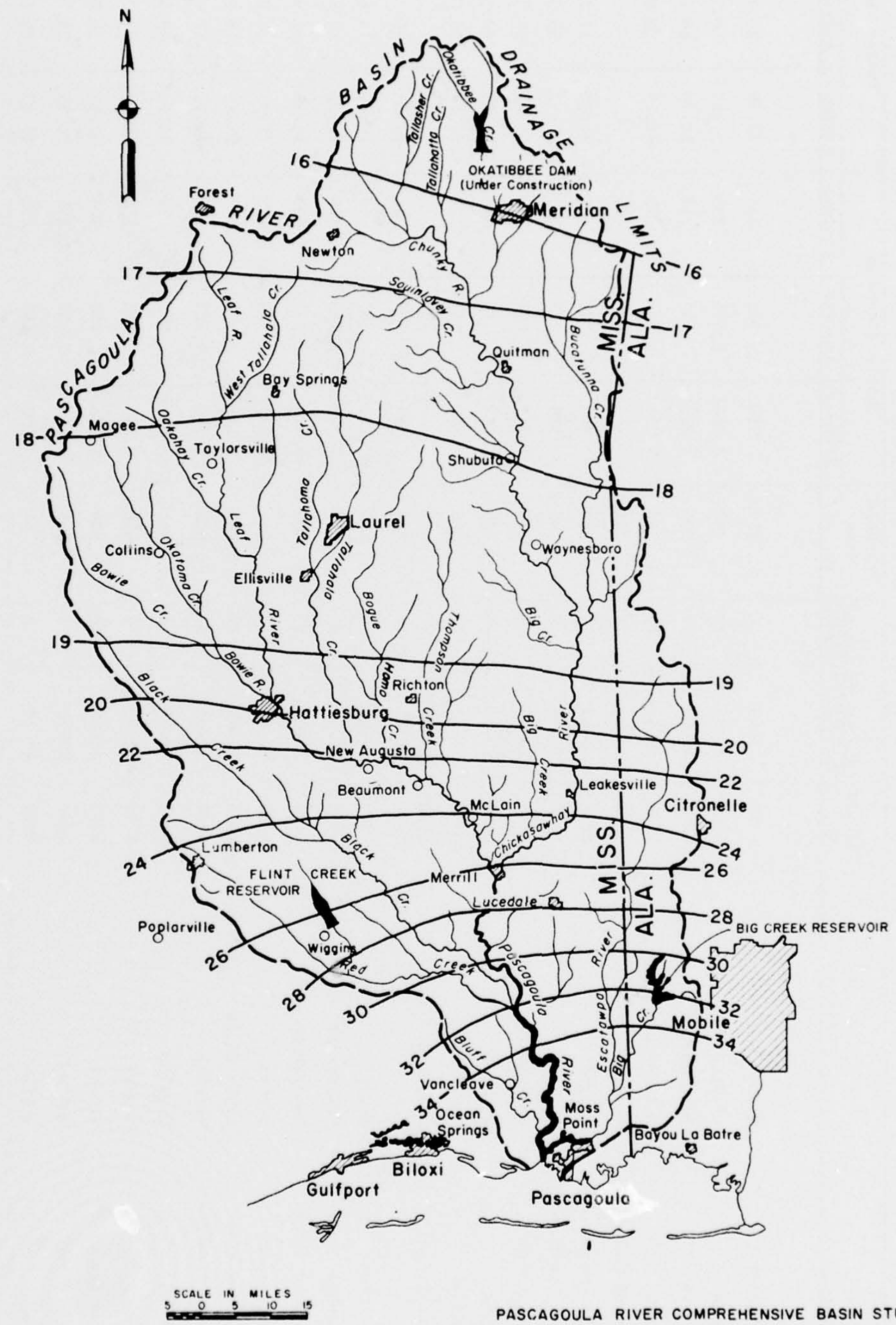
5/Interstate Highway 59 bridge, 1½ miles north of intersection of Highways 49 and 11 Truck Route Hattiesburg.
6/State Highway 51 bridge, 1/2 mile southeast of Laurel city limits, 6 miles upstream from Tallahoma Creek.
7/County highway bridge, 2 miles north of Mahned.
8/County highway bridge, 6 miles northeast of New Augusta.
9/County highway bridge, 1½ miles east of Hintonville.
10/County highway bridge, 5 miles east of Beaumont.
11/County highway bridge, 3 miles north of McLain.
12/State Highway 494 culvert 6' x 5', 1.2 miles southeast of Little Rock.
13/State Highway 15 bridge, 2½ miles south of Newton.
14/State Highway 15 culvert 10'x 8', 2.6 miles north of Baxter.
15/State Highway 18 double 5' x 5' culvert, 3.0 miles southwest of Rose Hill.
16/County highway bridge, 2 miles southwest of Shubuta.
17/County highway bridge, 1/2 mile northwest of Waynesboro.
18/County highway bridge, 0.3 miles east of Denham.
19/County highway bridge, 3 miles northeast of Buckatunna.
20/County highway bridge, 10 miles southwest of Buckatunna.
21/U. S. Highway 11 bridge, 4 miles northeast of Purvis.
22/U. S. Highway 49 bridge, 3 miles northwest of Brooklyn.
23/County highway bridge, 0.5 mile north of Vestry.
24/U. S. Highway 98 bridge, 4 miles northwest of Wilmer.
25/County highway bridge, 4.2 miles southeast of Hurley.

f. Annual maximum 1951-61; Low flow 1953-57, 1959-60.
g. Low flow 1943, 1945, 1951-57, 1960.
h. Low flow 1943, 1951-55.
i. Regular 1938-50; Annual maximum 1951-59; Low flow 1964-65.
j. Annual maximum 1956-58; Low flow 1956-57, 1959-60, 1964-65.
k. Regular Jan. 1939-Sep. 1949; Low flow 1953-58.
l. Low flow 1954-60.
m. Low flow 1952-57.
n. Low flow 1956-57, 1960.
o. Low flow 1958-64
p. Low flow 1953-57, 1959, 1963-64.
q. Low flow 1952-59.
r. Annual maximum 1953-54.
s. Annual maximum and low flow 1961-65.
t. Low flow 1958-63.



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

LOCATION OF STREAM GAGING STATIONS



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

AVERAGE ANNUAL LOCAL RUNOFF IN INCHES

(PERIOD 1939-60)

Prepared from data furnished by U.S. Geological Survey

FIGURE 7

Table 6

Yearly maximum, average, and minimum discharge and runoff for selected stations in the Pascagoula River Basin 1/

Stream	Station	Station No.	Period of record: Interval	Period of record: Years	Drainage area sq. mi.	Yearly discharge in c.f.s.: Maximum	Yearly discharge in c.f.s.: Average	Yearly discharge in c.f.s.: Minimum	Yearly runoff in inches: Maximum	Yearly runoff in inches: Average	Yearly runoff in inches: Minimum
Oakohay Creek	Mize	4715	43-49	6	217	524	335	256	32.79	20.99	15.97
Leaf River	Collins	4720	38-65	27	752	2,086	1,038	393	37.67	18.74	7.09
Bowie Creek	Hattiesburg	4725	38-65	27	304	868	445	213	38.75	19.88	9.53
Leaf River	Hattiesburg	4730	38-65	27	1,760	5,035	2,595	1,191	38.85	20.03	9.17
Tallahattah Creek	Waldrup	4734.8	65	1	30.7	--	--	--	--	--	--
Tallahala Creek	Laurel	4735	38-65	27	233	704	329	109	40.98	19.16	6.36
Tallahoma Creek	Laurel	4740	40-48	8	149	326	223	122	29.72	20.35	11.15
Tallahala Creek	Runnelstown	4745	39-65	26	612	1,949	901	330	43.21	20.01	7.32
Leaf River	McLain	4750	39-65	26	3,510	11,060	5,319	2,024	42.75	20.58	7.81
Chunky River	Chunky	4755	38-65	27	368	883	462	171	32.58	17.06	6.30
Okatibbee Creek	Meridian	4760	38-50 61-65	16	239	664	339	85.1	37.72	19.27	4.82
Sowashee Creek	Meridian	4765	50-65	15	51.9	108	56.7	19.4	28.25	14.86	5.08
Chickasawhay River	Enterprise	4770	38-65	27	913	2,348	1,169	428	34.92	17.40	6.37
Chickasawhay River	Waynesboro	4775	38-50	12	1,660	4,524	2,575	1,608	36.99	21.07	13.16
Bucatunna Creek	Denham	4780	38-49	11	468	1,338	789	432	38.82	22.90	12.56
Chickasawhay River	Leakesville	4785	38-65	27	2,680	7,710	3,691	1,397	39.05	18.71	7.09
Pascagoula River	Merrill	4790	30-65	35	6,600	19,410	9,529	3,718	39.91	19.61	7.64
Flint Creek	Wiggins	4792	57-65	8	24.8	72.4	53.9	32.2	39.62	29.51	17.60
Red Creek	Vestry	4793	58-65	7	416	1,277	851	358	41.68	27.79	11.68
Escatawpa River	Wilmer	4795	45-65	20	506	1,625	978	364	43.57	26.26	9.75
Escatawpa River	Hurley	4796	58-60	2	639	1,465	1,400	1,334	31.13	29.78	28.43
Big Creek	Mobile	4800	45-50	5	84	282	242	180	45.63	39.16	29.13

1/ Based on records through September 1965

Table 7

Average monthly runoff in inches for selected stations in the Pascagoula River Basin 1/

Stream	Station	Station No.	Period of record Interval	Period of record Years	Drainage area sq. mi.	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Yearly
Oakohay Creek	Mize	4715	43-49	6	217	0.19	1.30	1.13	3.26	3.94	3.97	2.78	1.95	0.65	0.71	0.74	0.36	20.99
Leaf River	Collins	4720	38-65	27	752	0.36	0.80	1.52	2.44	3.33	3.52	2.84	1.57	0.58	0.88	0.51	0.40	18.74
Bowie Creek	Hattiesburg	4725	38-65	27	304	0.70	1.20	1.87	2.18	2.88	3.22	2.42	1.56	0.94	1.11	0.89	0.91	19.88
Leaf River	Hattiesburg	4730	38-65	27	1,760	0.58	1.00	1.76	2.34	3.05	3.43	2.78	1.72	0.86	1.07	0.75	0.70	20.03
Tallahattah Creek	Waldrup	4734.8	65	1	30.7	--	--	--	--	3.72	3.60	0.75	0.18	0.20	0.14	0.24	0.13	--
Tallahala Creek	Laurel	4735	38-65	27	233	0.25	0.77	1.66	2.39	3.38	3.99	3.11	1.61	0.54	0.81	0.38	0.27	19.16
Tallahoma Creek	Laurel	4740	40-48	8	149	0.15	0.47	1.84	3.35	2.95	5.37	3.39	1.32	0.54	0.37	0.37	0.23	20.35
Tallahala Creek	Runnelstown	4745	39-65	26	612	0.38	0.84	1.88	2.36	3.26	3.86	3.04	1.76	0.62	0.99	0.54	0.47	20.01
Leaf River	McLain	4750	39-65	26	3,510	0.53	0.92	1.94	2.29	3.03	3.69	2.95	1.86	0.82	1.09	0.75	0.70	20.58
Chunky River	Chunky	4755	38-65	27	368	0.20	0.71	1.46	2.28	3.19	3.52	2.56	1.25	0.49	0.82	0.34	0.23	17.06
Okatibbee Creek	Meridian	4760	38-50,61-65	16	239	0.11	0.70	1.84	2.76	3.29	3.85	2.88	1.45	0.70	0.99	0.44	0.27	19.27
Sowashee Creek	Meridian	4765	50-65	15	51.9	0.28	0.48	1.54	1.62	2.63	3.40	2.33	0.83	0.47	0.82	0.24	0.21	14.86
Chickasawhay River	Enterprise	4770	38-65	27	913	0.21	0.66	1.49	2.16	3.11	3.52	2.77	1.34	0.55	0.89	0.41	0.27	17.40
Chickasawhay River	Waynesboro	4775	38-50	12	1,660	0.26	0.70	1.69	2.61	3.24	4.24	3.03	1.94	0.89	1.30	0.70	0.46	21.07
Bucatunna Creek	Denham	4780	38-49	11	468	0.18	0.66	1.76	2.65	3.23	5.16	3.61	2.04	1.02	1.33	0.77	0.48	22.90
Chickasawhay River	Leakesville	4785	38-65	27	2,680	0.36	0.65	1.61	2.02	2.70	3.63	3.11	1.73	0.80	1.00	0.63	0.47	18.71
Pascagoula River	Merrill	4790	30-65	35	6,600	0.49	0.81	1.69	2.35	2.77	3.46	3.07	1.72	0.84	1.05	0.77	0.60	19.61
Flint Creek	Wiggins	4792	57-65	8	24.8	1.67	2.06	2.64	2.85	3.18	3.56	2.95	2.46	2.39	1.98	1.84	1.91	29.51
Red Creek	Vestry	4793	58-65	7	416	1.22	1.46	2.78	2.95	3.91	3.67	3.44	1.96	2.02	1.34	1.48	1.56	27.79
Escatawpa River	Wilmer	4795	45-65	20	506	0.76	1.64	2.60	2.58	2.94	4.09	3.48	1.88	1.64	1.79	1.44	1.43	26.26
Escatawpa River	Hurley	4796	58-60	2	639	2.28	1.24	1.14	2.00	3.83	2.80	3.65	3.10	4.58	1.61	1.62	1.92	29.78
Big Creek	Mobile	4800	45-50	5	84	1.87	3.22	2.99	3.18	2.44	5.15	3.90	3.47	2.55	3.43	3.09	3.86	39.16

1/ Based on records through September 1965.

Minimum stages and discharges. As indicated in Table 5, minimum stages and discharges occurred at various times throughout the basin, usually in the fall of the year. The flow of several streams in the basin ceases entirely during that season and the discharge of many other streams becomes negligible. Extreme low stages and discharges at most of the stations in the basin occurred in October 1954 and October 1963.

FLOODS

General. Basin-wide floods usually occur during the winter and spring months, being associated with frontal type storms that generally last from 2 to 4 days and produce 6 or more inches of rainfall over the basin. In summer, general flooding may result from the inland passage of a tropical hurricane. Usually, however, floods during the summer are of a local nature and result from thunderstorms with high intensities over small areas.

Floods of record. General flooding of a severe nature occurred during the years 1900, 1916, 1919, 1938 and 1961. Severe floods in other years, such as the flood of April 1964, were confined to parts of the basin. The most severe and disastrous basin-wide flood known to have been caused by a frontal-type storm occurred in April 1900, although historical records indicate that this was probably exceeded in earlier years. Of the tropical hurricanes, the one of July 1916 produced the greatest known flood stages in the lower part of the basin. The most recent general floods were during 1961, especially during late February and early March when more than 30 inches of rain fell in some areas. The storm of 17-25 February 1961 produced some record-breaking peaks and prolonged inundation at various stations throughout the basin. As a result of this storm, the crest at Merrill on the Pascagoula River was the highest recorded since July 1916. Throughout the basin, heavy damage was inflicted to highways, railroads, urban areas, and farms. In addition, three persons lost their lives at Hattiesburg.

The maximum floods of record at various locations throughout the basin are given in Table 5.

Flood frequency analyses. Economic analyses for flood control depend on the flood frequencies of the stream under study. Individual records in general consist of relatively few events and consequently, by themselves, are a rather poor guide to future probabilities. The frequency analysis must therefore draw on information other than that contained in the local records. This is done by combining available information through use of statistical processes and by using general accumulated knowledge. A regional flood frequency analysis for the

Pascagoula River Basin was made in accordance with methods presented in the publication, "Statistical Methods in Hydrology", by Leo R. Beard, Office of the Chief of Engineers, Department of the Army, January 1962.

Basic data were obtained from records for 26 stations in the Pascagoula River Basin. Historical data pertaining to peak stages of floods prior to record collection were used when there was reasonable comparability to present stage-discharge relationships. With the combined data, two stations in the basin, Leaf River at Hattiesburg (1,760-square-mile drainage area) and Pascagoula River at Merrill (6,600-square-mile drainage area), had a 61-year record. The others varied from 10 to 55 years. The records were carefully screened to eliminate or correct flows affected by man-made influences. Data for the annual peaks were tabulated from the records.

The determination of frequency statistics from individual discharge records required the computation of means and standard deviations, using data from each station and the following equations:

$$m = \frac{\Sigma X}{N}$$

$$\bar{s}^2 = \frac{\Sigma X^2 - \frac{(\Sigma X)^2}{N}}{N - 1}$$

$$g = \frac{N \Sigma x^3}{(N - 1)(N - 2)\bar{s}^3}$$

where: Σ = Summation

X = Log to base 10 of annual peak

N = Length of record in years

m = Mean of logs of annual peaks

$\bar{s}$ = Standard deviation of logs of annual peaks

g = Coefficient of skew

x = X - m

The annual peaks for the period of record of the short-term stations were correlated with those for comparable years at the long-term stations. The computed statistics m and $\bar{s}$ for the long-term stations were then used to adjust the same statistics for the short-term stations. The weighting factor for these adjustments was the coefficient of determination (square of the coefficient of correlation) computed in the correlations between the long-term and short-term stations. This computation materially increases the reliability of the individual frequency statistics.

Table 8 is a summary of peak frequency statistics for selected stations in the Pascagoula River Basin. A generalized composite regional frequency curve for the basin is shown on Figure 8 and examples of the computed record and adjusted extended record for selected stations are shown on Figures 9, 10, and 11.

LOW FLOW STUDIES

General. Low flow studies were divided into two general categories. One consisted of the analyses necessary to determine minimum flows under existing conditions. The other category encompassed the studies necessary to determine reservoir storage requirements for augmentation of existing streamflow to satisfy water quality and water supply needs. The minimum flows under existing conditions are discussed in the following paragraph. Studies of reservoir storage requirements for water quality and water supply needs are discussed later in this section under "WATER QUALITY CONTROL AND WATER SUPPLY STORAGE."

Present minimum flows. Studies of existing minimum flow were made to provide the Federal Water Pollution Control Administration with the minimum average 7-day low flow for a 10-year recurrence interval at numerous points throughout the basin. Basic data prepared by the U. S. Geological Survey were used to correlate short-record values and provide the means for estimating low flow frequencies for locations where data were not available. Table 9 summarizes the minimum flow-duration-frequency data developed for selected stations in the basin and the minimum discharges for the period 1938-64.

Table 8

Summary of peak frequency statistics for selected stations in the Pascagoula River Basin 1/

Stream	Station	Station No.	Drainage area sq. mi.	Statistics based on Record			Statistics based on extended record			Final adjusted statistics	
				Years	m 2/	$\bar{s}$ 3/	Equiv. Years	m	$\bar{s}$	m	$\bar{s}$
Leaf River	Raleigh	4711	143	12	3.536	.330	21	3.578	.301	3.721	.325
Oakohay Creek	Mize	4715	217	10	3.756	.214	13	3.712	.217	3.872	.318
Leaf River	Collins	4720	752	27	4.136	.249	40	4.196	.261	4.190	.292
Bowie Creek	Hattiesburg	4725	304	27	3.777	.295	37	3.843	.308	3.879	.310
Leaf River	Hattiesburg	4730	1,760	61	4.417	.217	--	--	--	4.423	.271
Tallahala Creek	Laurel	4735	233	27	3.712	.346	42	3.800	.364	3.787	.315
Tallahala Creek	Runnelstown	4745	612	26	3,917	.262	49	3.984	.275	4.009	.296
Buck Creek	Runnelstown	4746.5	19.1	13	3.104	.444	13	3.155	.444	3.170	.365
Leaf River	McLain	4750	3,510	26	4.581	.215	54	4.639	.226	4.630	.258
Tarlow Creek	Newton	4753.5	15.9	13	3.273	.378	21	3.386	.377	3.230	.370
Chunky Creek	Chunky	4755	368	27	3.915	.318	36	3.985	.331	4.009	.309
Okatibbee Creek	Meridian	4760	239	27	3.667	.392	36	3.750	.408	3.879	.314
Sowashee Creek	Meridian	4765	51.9	24	3.441	.305	30	3.509	.316	3.534	.344
Chickasawhay River	Enterprise	4770	913	28	4.178	.316	40	4.232	.317	4.253	.288
Pachuta Creek	Pachuta	4771.5	23	13	3.348	.388	18	3.470	.369	3.248	.361
Chickasawhay River	Shubuta	4773.5	1,[illegible]60	55	4.287	.293	59	4.276	.294	4.314	.277
Chickasawhay River	Waynesboro	4775	1,660	24	4.235	.236	41	4.274	.241	4.312	.272
Bucatunna Creek	Denham	4780	468	13	3.944	.222	27	3.921	.228	3.892	.301
Chickasawhay River	Leakesville	4785	2,680	28	4.370	.222	52	4.417	.223	4.377	.262
Pascagoula River	Merrill	4790	6,600	61	4.813	.220	--	--	--	4.813	.242
Big Creek	Lucedale	4790.4	22	14	3.157	.429	15	3.244	.422	3.316	.362
Wells Creek	Brooklyn	4791.4	22.3	14	3.236	.441	16	3.318	.445	3.246	.360
Red Creek	Lumberton	4791.8	15.6	15	3.031	.363	20	3.138	.359	3.204	.370
Red Creek	Wiggins	4791.9	168	14	3.726	.282	18	3.811	.276	3.761	.321
Flint Creek	Wiggins	4792	24.8	11	3.197	.276	13	3.246	.265	3.258	.360
Escatawpa River	Wilmer	4795	506	20	4.047	.262	23	4.089	.265	3.998	.300

1/ Based on records through September 1965.
2/ m = Mean of the logs of annual peaks.
3/ $\bar{s}$ = Standard deviation of the logs of annual peaks.

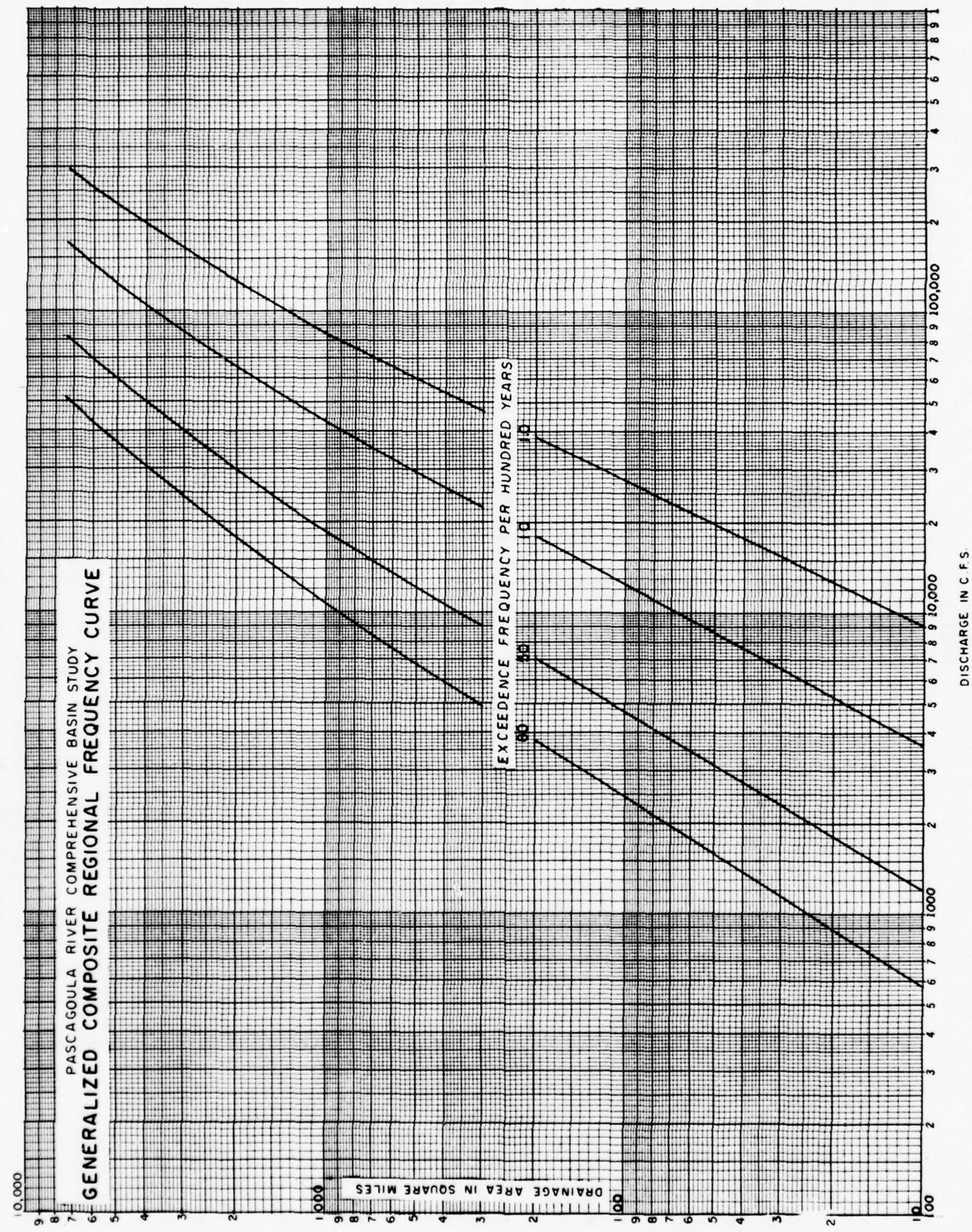

PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY
GENERALIZED COMPOSITE REGIONAL FREQUENCY CURVE
EXCEEDENCE FREQUENCY PER HUNDRED YEARS
1.0
10
50
80
DRAINAGE AREA IN SQUARE MILES
DISCHARGE IN C.F.S.
10,000
1000
100
10
100,000

FIGURE 8

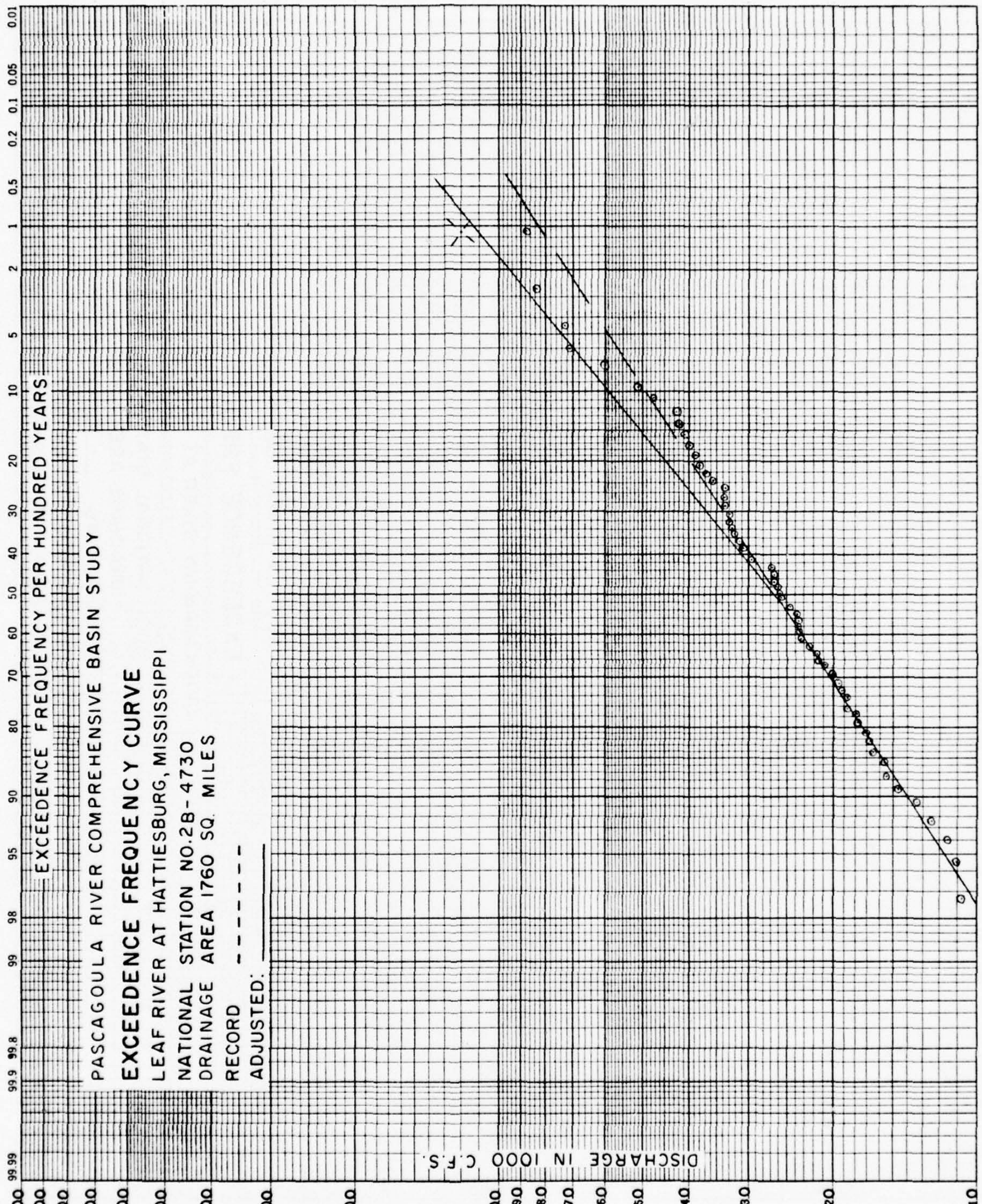

EXCEEDENCE FREQUENCY PER HUNDRED YEARS
PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY
EXCEEDENCE FREQUENCY CURVE
LEAF RIVER AT HATTIESBURG, MISSISSIPPI
NATIONAL STATION NO. 2B-4730
DRAINAGE AREA 1760 SQ. MILES
RECORD
ADJUSTED:
DISCHARGE IN 1000 C.F.S.

FIGURE 9

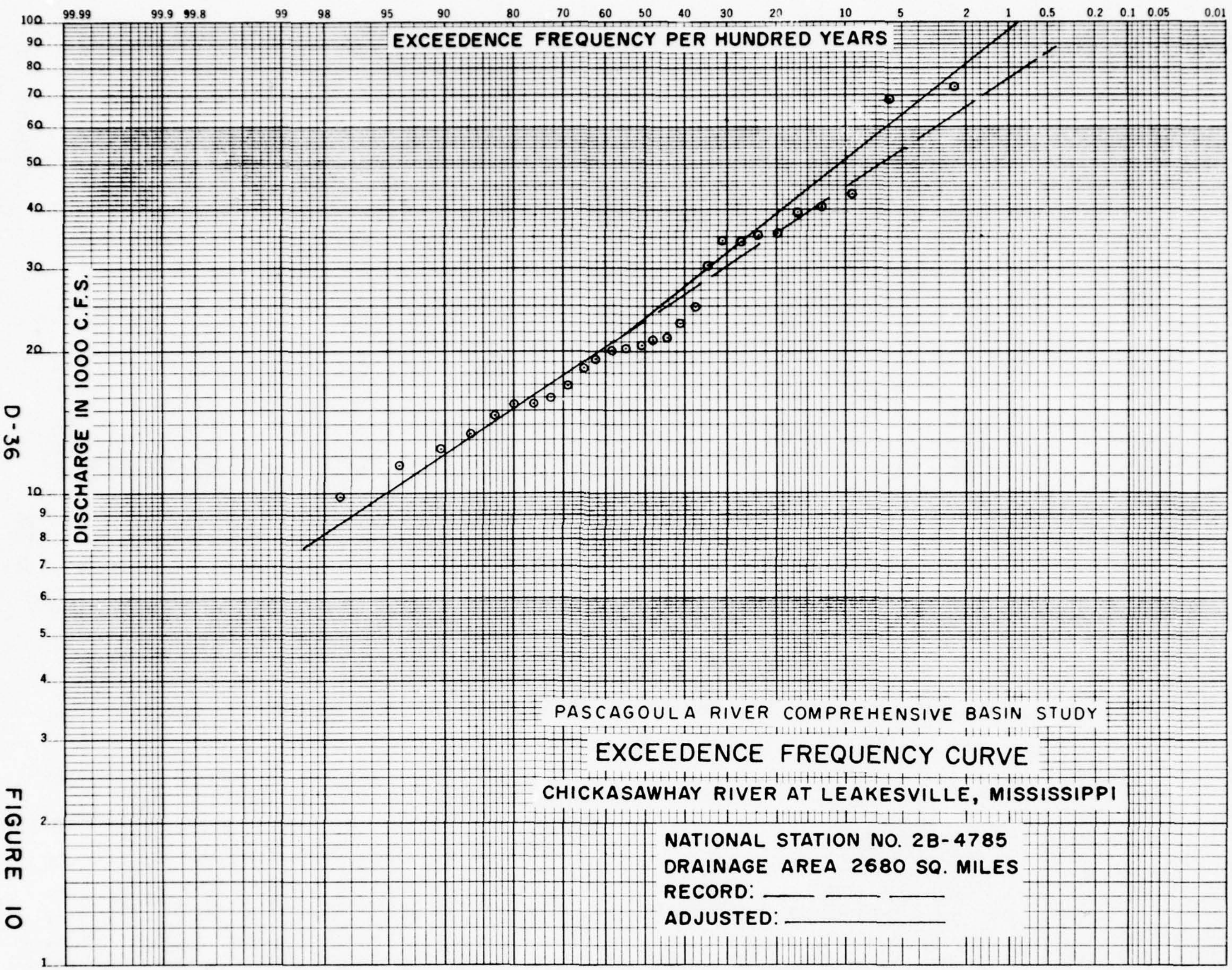

EXCEEDENCE FREQUENCY PER HUNDRED YEARS
99.99 99.9 99.8 99 98 95 90 80 70 60 50 40 30 20 10 5 2 1 0.5 0.2 0.1 0.05 0.01
DISCHARGE IN 1000 C.F.S.
100 90 80 70 60 50 40 30 20 10 9 8 7 6 5 4 3 2 1
PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY
EXCEEDENCE FREQUENCY CURVE
CHICKASAWHAY RIVER AT LEAKESVILLE, MISSISSIPPI
NATIONAL STATION NO. 2B-4785
DRAINAGE AREA 2680 SQ. MILES
RECORD:
ADJUSTED:

FIGURE 10

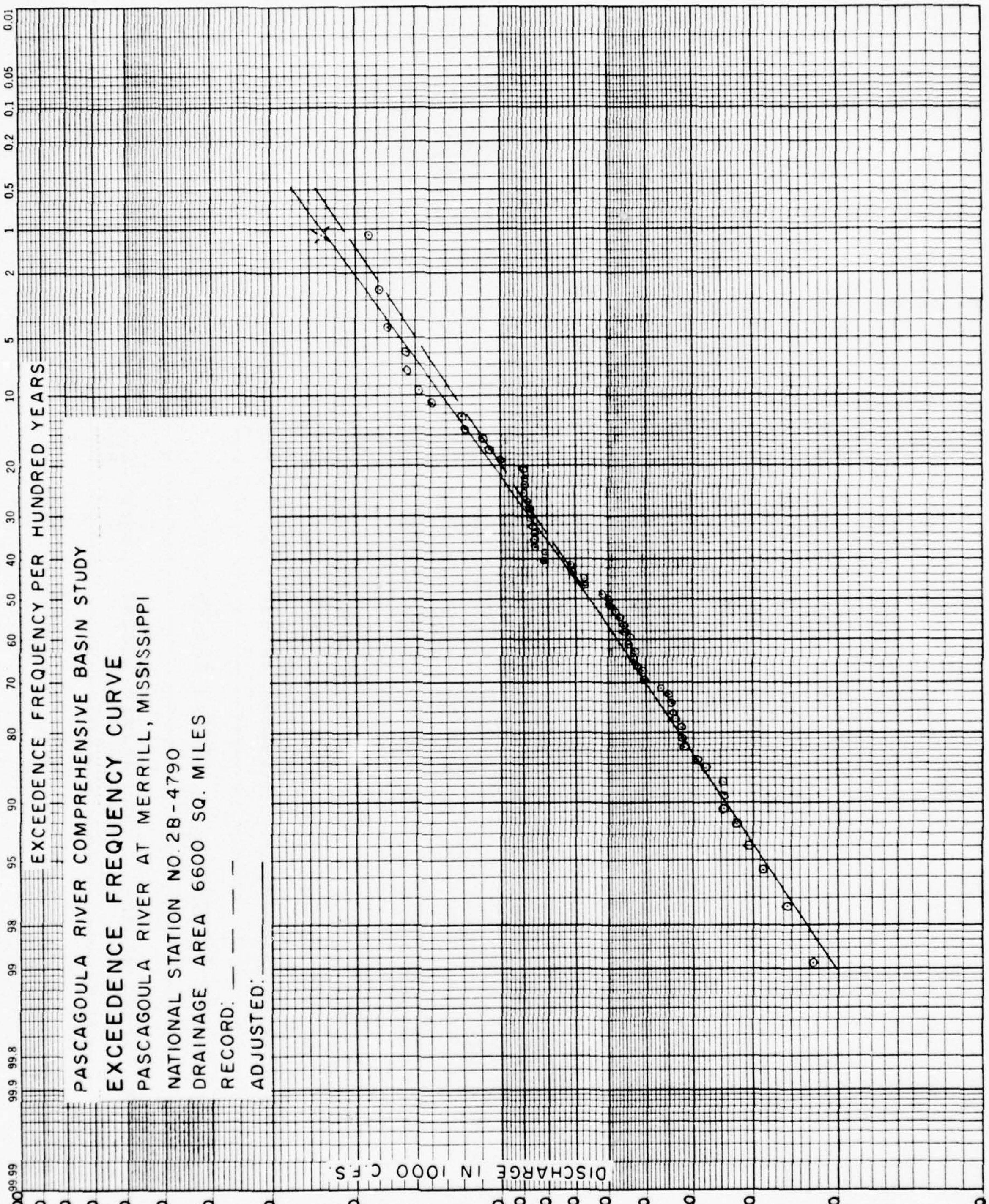

EXCEEDENCE FREQUENCY PER HUNDRED YEARS
PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY
EXCEEDENCE FREQUENCY CURVE
PASCAGOULA RIVER AT MERRILL, MISSISSIPPI
NATIONAL STATION NO. 2B-4790
DRAINAGE AREA 6600 SQ. MILES
RECORD:
ADJUSTED:
DISCHARGE IN 1000 C.F.S.

FIGURE 11

Table 9

Magnitude and frequency of annual low flows and estimated minimum discharges for selected stations in the Pascagoula River Basin

Station No.	Station name	Drainage area (sq.mi.)	Period (Consecutive days)	Annual low flow, in cubic feet per second, for indicated recurrence interval, in years. (Data submitted to base period, 1929-57) 1.03	1.2	2	5	10	20	30	Estimated minimum discharge 1938-64 (c.f.s.)
4720	Leaf River near Collins	752	7	182	123	86	70	63	56	53	55[a]
			15	197	132	90	73	66	59	56	
			30	236	152	98	77	69	62	58	
			60	322	194	118	86	76	68	64	
			120	495	280	159	112	98	86	80	
			183	870	445	228	150	127	109	100	
4725	Bowie Creek near Hattiesburg	304	7	208	152	118	100	91	84	80	83[a]
			15	225	165	125	105	95	88	84	
			30	252	180	132	108	99	91	87	
			60	305	214	154	118	108	97	92	
			120	335	240	176	140	128	115	110	
			183	465	310	216	166	150	136	130	
4730	Leaf River at Hattiesburg	1,760[b]	7	810	600	455	372	340	314	298	18[a]
			15	870	640	480	390	355	330	312	
			30	950	690	510	410	375	342	328	
			60	1,180	820	590	455	410	370	350	
			120	1,520	1,050	740	560	495	450	425	
			183	2,050	1,380	930	690	610	545	510	
4735	Tallahala Creek at Laurel	233	7	36	17	7.3	3.9	2.8	2.1	1.8	1.8
			15	40	19	8.5	4.5	3.3	2.4	2.0	
			30	53	25	11	5.3	3.8	2.8	2.3	
			60	80	39	16	7.3	5.1	3.6	3.0	
			120	148	65	29	16	10	7.2	5.8	
			183	278	122	54	28	19	13	11	
4745	Tallahala Creek near Runnelstown	612	7	150	90	57	44	38	33	31	29[a]
			15	170	100	62	47	41	35	33	
			30	210	118	68	50	43	37	34	
			60	295	162	86	57	48	42	38	
			120	460	250	130	81	68	57	51	
			183	780	415	202	118	95	78	70	
4750	Leaf River near McLain	3,510[b]	7	1,380	1,000	740	600	550	505	480	478[a]
			15	1,480	1,050	780	640	580	530	500	
			30	1,600	1,140	840	670	610	560	525	
			60	2,150	1,400	960	740	660	600	560	
			120	2,950	1,840	1,230	920	820	730	690	
			183	4,200	2,500	1,600	1,160	1,020	900	840	
4775	Chickasawhay River near Waynesboro	1,660[b]	7	440	270	170	120	102	88	78	94[a]
			15	475	290	184	130	110	94	84	
			30	560	330	200	140	118	100	90	
			60	800	450	260	170	140	115	106	
			120	1,200	645	375	245	200	165	150	
			183	1,860	970	540	340	270	225	200	
4780	Bucatunna Creek at Denham	468	7	93	50	24	14	11	8.2	--	6.2
			15	104	55	27	16	12	9.4	--	
			30	124	67	32	17	13	10	--	
			60	188	102	48	24	17	13	--	
			120	278	160	80	42	31	23	--	
			183	480	245	118	69	51	38	--	
4785	Chickasawhay River at Leakesville	2,680[b]	7	795	495	328	242	212	186	172	160[a]
			15	850	530	348	260	228	198	182	
			30	1,000	600	380	274	239	208	192	
			60	1,410	810	480	325	272	236	218	
			120	2,080	1,150	680	450	375	320	290	
			183	3,190	1,710	970	620	495	418	380	
4790	Pascagoula River at Merrill	6,600	7	2,560	1,730	1,230	962	861	774	720	696[c]
			15	2,740	1,840	1,290	1,020	904	808	760	
			30	3,090	2,030	1,400	1,070	948	848	800	
			60	4,090	2,580	1,690	1,220	1,050	940	880	
			120	5,630	3,500	2,240	1,590	1,360	1,200	1,120	
			183	7,900	4,800	3,030	2,080	1,730	1,520	1,400	
4795	Escatawpa River near Wilmer	506	7	300	171	102	66	50	38	27	37[a]
			15	342	193	113	74	56	43	30	
			30	393	218	124	82	63	49	35	
			60	528	302	166	106	82	63	45	
			120	702	435	245	148	120	98	75	
			183	894	616	376	224	170	138	107	

[a] Based on observed data. [b] Approximately. [c] Observed in 1936, 707 cfs in 1963.

PART D — HYDROLOGIC DESIGN CRITERIA

SYNTHETIC FLOOD HYDROGRAPHS AT SELECTED DAMSITES

General. Detailed studies were made only of those major reservoir projects that appeared to be economically feasible and needed in a possible early-action program of construction within the next 10 to 15 years. These projects were: Tallahala Reservoir on Tallahala Creek above Laurel; Taylorsville Reservoir on Leaf River above Hattiesburg; Bowie Reservoir on Bowie Creek; Mize Reservoir on Oakohay Creek; and Harleston Reservoir on Escatawpa River. A plan for development of the Tallahala Reservoir was presented in an interim report submitted by the Corps of Engineers in April 1966 and now awaiting authorization by the Congress. Detailed studies for the Taylorsville, Bowie, Mize, and Harleston Reservoirs are included in the present report.

Synthetic flood hydrographs were developed at the Taylorsville, Bowie, Mize, and Harleston damsites since there were no stream gaging stations at these locations. The hydrographs were based on rainfall for various frequencies as taken from U. S. Weather Bureau Technical Papers Nos. 40 and 49. It was assumed that the effective rainfall for a particular frequency would produce a flood of the same frequency. This procedure is considered sufficiently accurate for the survey scope of this report. Should any of these projects be authorized, synthetic flood hydrographs would be reinvestigated in more detail during the advanced planning stage and an analysis of the records of nearby stream gaging stations would be made.

Synthetic unit hydrographs. Unit hydrographs from actual floods of record for the U. S. Geological Survey stream gaging stations were modified by Snyder's method and transferred to the Taylorsville, Bowie, Mize and Harleston damsites as synthetic unit hydrographs at these locations.

Flood hydrographs – 2-year to 100-year frequencies. The 48-hour rainfalls for the 2-, 10-, 50-, and 100-year frequencies were used to develop the flood hydrographs at each damsite. A constant loss of 0.05 inch per hour was subtracted to give the rainfall excess. The adopted unit hydrograph at each damsite was applied to the respective rainfall excess and a base flow of 2.5 c.f.s. per square mile added to obtain the flood hydrograph.

Spillway design floods. Spillway design floods were developed at each damsite based on probable maximum precipitation as contained in U. S. Weather Bureau "Hydrometeorological Report No. 33." The 48-hour rainfall was reduced by a constant loss of 0.05 inch per hour to give the rainfall excess. Runoff was obtained by applying the adopted

unit hydrograph for the specific damsite to the rainfall excess. A base flow of 2.5 c.f.s. per square mile was added to give the spillway design flood hydrograph.

Standard project floods. The standard project flood is defined as the flood that may be expected from the most severe combination of meteorologic and hydrologic conditions that are considered reasonably characteristic of the area, excluding extremely rare combinations. Based on criteria contained in Civil Engineer Bulletin No. 52-B, Corps of Engineers, 50 percent of the spillway design storm runoff was adopted as the standard project storm runoff. A base flow equal to the one included in the spillway design flood was added to give the standard project flood hydrograph.

WATER QUALITY CONTROL AND WATER SUPPLY STORAGE

General. Studies by the Federal Water Pollution Control Administration in close cooperation with the Corps of Engineers indicated that storage for water quality control and water supply in the Harleston Reservoir and water supply in the Bowie Reservoir are needed and desired. For water quality control below the Harleston damsite, minimum monthly flow requirements on the Escatawpa River near Orange Grove were determined by the Federal Water Pollution Control Administration. These requirements were used for planning conservation storage. Allowances were made for 100 million gallons per day in the Harleston Reservoir and 108 million gallons per day in the Bowie Reservoir for municipal and industrial water supply to help meet portions of the present and projected needs of the areas.

Storage requirements. Storage requirements for the Harleston Reservoir were determined through the use of synthetic monthly flows at the damsite for the period 1945-1965. These flows were developed from streamflow records at the U. S. Geological Survey gage on the Escatawpa River at Wilmer. The allotted storage in the reservoir between elevations 54.5 and 85.5 would provide 30,300 acre-feet, or 1.0 inch of runoff, for domestic and industrial water supply, and 228,500 acre-feet, or 7.3 inches of runoff, for water quality control. An additional 16,700 acre-feet, or 0.5 inch of runoff, would be available for sedimentation accumulation below elevation 54.5.

The allotted storage in the Bowie Reservoir would provide 74,400 acre-feet (4.8 inches of runoff) for domestic and industrial water supply between elevations 236.0 and 210.0. Below elevation 210.0 there are 5,600 acre-feet (0.4 inch of runoff) available for sedimentation. The water supply storage was determined through the use of a storage-draft curve prepared from streamflow records for the period 1938-1965 at the U. S. Geological Survey gage on Bowie Creek just downstream from the damsite and adjusted for use at the damsite.

FLOOD STORAGE

In flood control studies, sufficient storage was provided above the conservation pool of all four projects for controlling floods of a given magnitude. Outflow in each case was limited to the average minimum continuous flow required by the State of Mississippi under its water rights law. Beyond that point, the project designs, featuring perched spillways, provided additional storage, not for flood control but in lieu of spillway capacity. As a result, maximum outflows for floods somewhat in excess of the standard project flood were limited to sluice capacity.

FLOOD REDUCTIONS

General. Downstream flood reductions were computed with Taylorsville, Bowie and Mize Reservoirs operating independently and in combinations. The following stream gaging sites were selected as reference points for damage reaches: Leaf River at Collins, Hattiesburg, Beaumont and McLain; Bowie Creek at Hattiesburg; and Oakohay Creek at Mize. Flood reductions were also computed below Harleston damsite on the Escatawpa River at Hurley, a discontinued stream gaging station.

Natural flood hydrographs. Synthetic 2-, 10-, 50- and 100-year flood hydrographs were computed at the selected downstream damage reference points. The 48-hour rainfall was developed in accordance with the U. S. Weather Bureau Technical Papers Nos. 40 and 49, with constant loss of 0.05 inch per hour subtracted to obtain the rainfall excess. Unit hydrographs developed at the downstream gages for the February 1961 flood were applied to the rainfall excess to give the storm runoff hydrographs. The Leaf River gage at Beaumont was discontinued prior to 1961 so the unit hydrograph at McLain for the 1961 flood was transferred to this site. Since the Escatawpa River gage at Hurley had also been discontinued, the unit hydrograph at Wilmer for the February 1961 flood was transferred to that site. A base flow of 2.5 c.f.s. per square mile was added to obtain the natural discharge hydrographs. Frequency curves were prepared at each damage site for natural conditions following criteria contained in Beard's "Statistical Methods in Hydrology." Stage frequency curves were constructed by applying the latest rating curves for these gages to the discharge frequency.

Revised flood hydrographs. Regulated flows at the damsites were subtracted from the natural flows to give the holdouts which were

used to determine the downstream effects of the individual projects. Routing of these holdouts to each of the damage points was accomplished by the progressive average-lag method. Revised flows were computed by subtracting the routed holdouts from the natural flows. This procedure was followed to determine revised peak discharges with the proposed reservoirs operating independently and in combinations. Discharge frequency curves for the improved conditions were constructed at each damage point by plotting the revised peaks at their respective frequencies. Revised stage frequency curves were obtained by applying the latest rating curve at each damage point to the revised discharge frequency.

SECTION 3 — FLOOD DAMAGES AND FLOOD CONTROL BENEFITS FOR MAIN STREAMS AND PRINCIPAL TRIBUTARIES

PART A — FLOOD DAMAGES

GENERAL

This part presents damage data for main streams and principal tributaries of the Pascagoula River system. It covers areas subject to flooding, the results of flood damage surveys, and average annual damage for the damage centers and reaches studied.

Data for areas upstream from the reaches described herein were considered by the Department of Agriculture in the analyses pertaining to small upstream watershed control structures and are contained in Appendix F.

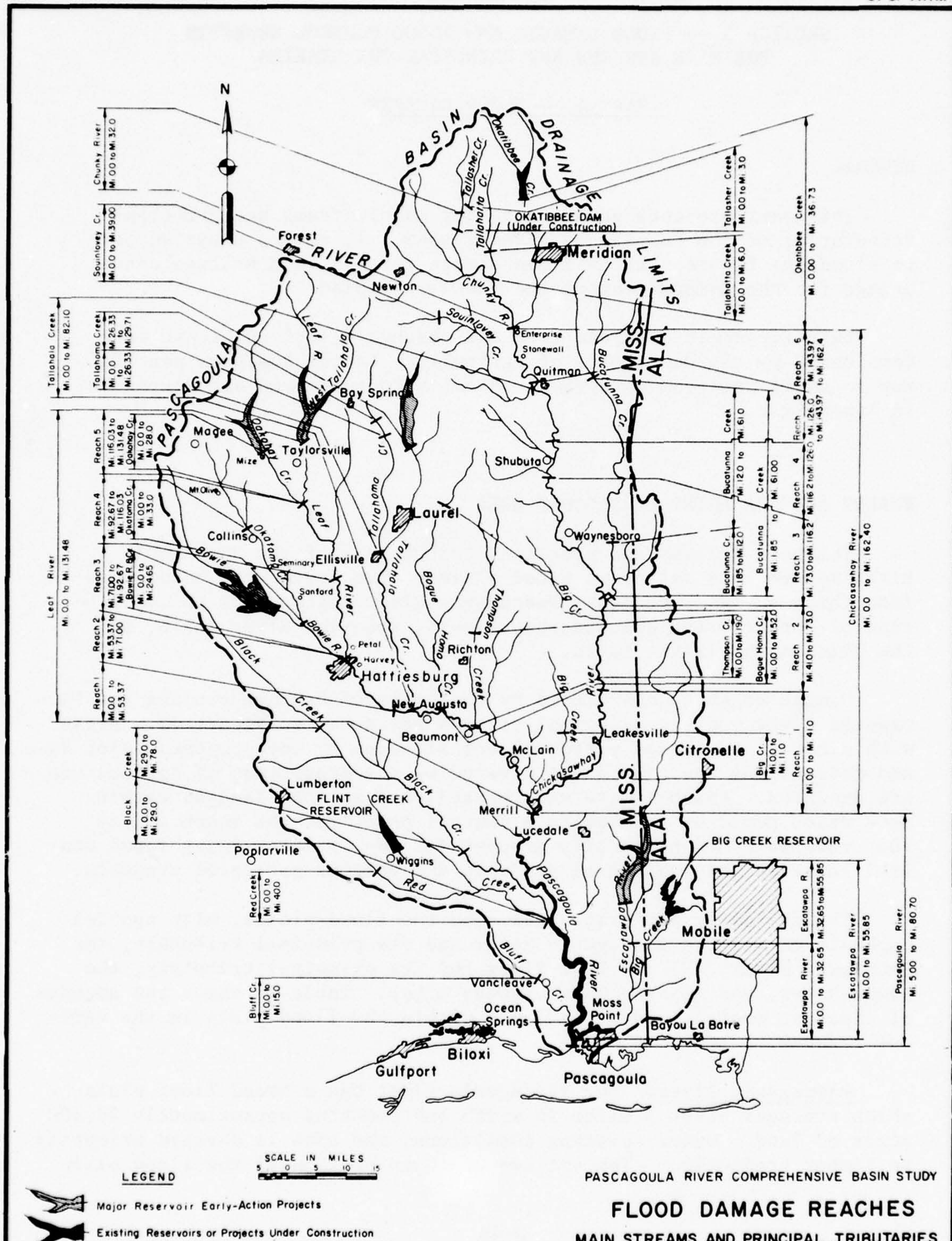
EXTENT AND CHARACTER OF FLOODED AREA

The main streams and principal tributaries of the Pascagoula River system have extensive flood plains. The system may be divided into three areas: the lower Pascagoula River Basin below the confluence of the Leaf and Chickasawhay Rivers, the Leaf River Basin, and the Chickasawhay River Basin.

Damage reaches considered by the Corps of Engineers along the Pascagoula River and all principal streams are shown on Figure 12. Areas with minor flood damage potential not affected by any proposed major dams and most of the upstream areas covered by the Department of Agriculture are excluded. Reach limits were established so that damages within each reach could be related to a control point for the reach and so that reaches could be readily grouped for use in determining flood control benefits for individual projects and various groups of projects.

The following paragraphs describe the flood plains, with special emphasis on (1) the Pascagoula River and its principal tributary, the Escatawpa River, (2) the Leaf River and its principal tributary, the Bowie River, and (3) the Chickasawhay River. Table 10 shows the amounts of cleared, wooded, and urban lands within the flood plain in the various reaches.

Pascagoula River. The Pascagoula River has a broad flood plain which averages about 3 miles in width and contains approximately 78,600 acres of land. Under existing conditions, the area is devoted primarily to timber production. The extreme southern portion of the flood plain



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

FLOOD DAMAGE REACHES

MAIN STREAMS AND PRINCIPAL TRIBUTARIES

FIGURE 12

consists of tidal marshland, which has limited use at the present time. The soils are unclassified alluvium. Under existing flooding conditions, the flood plain cannot be used for crop or pasture production. Presently the best use is for the production of timber species that flourish in wet areas, such as cypress, gums, juniper and some oaks. The major highways cross the flood plain on fills that are seldom flooded; however, some of the secondary roads are inundated after flows reach medium highwater stages. Other minor improvements, such as fishing camps, are also subject to flooding.

Escatawpa River. There are approximately 17,300 acres of rural land subject to flooding from the Escatawpa River, which has a flood plain averaging about a half mile in width. The flood plain has very little development and is practically uninhabited; approximately 98 percent of it is in timber. The soils are unclassified alluvium and under existing conditions cannot be developed for the production of crops or for pastures. Species of trees adapted to the conditions that exist are growing on the bottomlands. The principal highways and railroads in the flood plain are on high embankments and seldom flood, but many of the secondary roads are at lower elevations and are frequently inundated.

Leaf River. Overflows from the Leaf River affect both urban and rural areas. The towns of McLain, Beaumont, New Augusta, Hattiesburg, Petal, and Harvey, occupying about 1,320 acres of flood plain lands developed for urban use, are inundated at high flood stages. In the rural areas, farms have been extended into the river bottoms and about 10 percent of the rural flood plain has been cleared for agricultural use. Below the proposed Taylorsville damsite, at mile 131.5, floods inundate 76,500 acres of woodland and 7,100 acres of cleared farmland. A large portion of the affected rural area is comprised of soils good for agricultural production. The less frequently flooded terraces consist of Amite and Cahaba soils; the lower bottoms contain mostly Tombigbee, Ocklockonee and Iuka. These soils have good physical properties and respond well to good soil management practices. Practically all of the bottomland soils will produce higher yields than upland soils in the area. Additional wooded bottomland will be converted to cropland in the future. With flood control, it would be at a faster rate and in a much greater amount. The principal highways and railroads in the flood plain are on high embankments and are seldom inundated, but many of the secondary roads are at lower elevations and are frequently flooded.

Bowie River and Bowie Creek. Bowie River is formed by the confluence of Bowie and Okatoma Creeks and flows about 14 miles to join the Leaf River at Hattiesburg. Along the 25-mile reach from the mouth of Bowie River to the proposed damsite on Bowie Creek, floods inundate about 7,000 acres of land in rural areas and 300 acres of urban lands

at Hattiesburg. In the rural flood plain, 1,500 acres are cleared and used principally for pasture and crops of corn, cotton and small grain; 5,500 acres have stands of hardwood and pine. Terrace and bottomland soils are principally Ochlockonee, Cahaba, and Kalmia which make good farmlands. Native fertility in these soils is low but good yields are realized with the use of fertilizers and sound soil management practices. The soils in much of the existing woodland in the flood plain would make good farmland and, if the flood hazard were appreciably reduced, considerable acreage of woods could be cleared and used for crops or pasture.

Principal highways are on high fills that are seldom inundated by floods but the secondary roads are frequently flooded. At Hattiesburg, the urban flood plain contains areas of residential, commercial and small industry uses.

Chickasawhay River. Floods inundate 87,500 acres along the Chickasawhay River, of which 1,500 acres are in the urban centers of Waynesboro, Shubuta and Stonewall, and the remaining 86,000 acres are rural. The towns are affected only by the higher floods but much of the rural area is covered at lower stages. Most of the flood plain soils make good farmlands. Although these soils are normally low in fertility, good crop yields are obtained by the use of fertilizers, lime and good soil management practices. Under existing conditions, there are 16,600 acres of cleared farmland being used for crop and pasture production in the flood plain. The Gulf, Mobile and Ohio Railroad is located in the flood plain most of the way from Bucatunna Creek to Meridian and is damaged by high flood stages. The major highways that cross the flood plain are on high fills and are subject to inundation only by the higher floods. Many of the secondary roads have little or no embankment and are inundated by the smaller floods as well as the larger ones.

Flood plains of tributary streams. The flood plains of the tributary streams in the Pascagoula River Basin are mostly rural, relatively narrow and have only a small percent of the area cleared and developed for agricultural use.

Lateral tributaries of the Pascagoula River are in the Coastal Flatwoods and the southern part of the Lower Coastal Plain. A very small part of these tributary flood plains has been developed for urban use and the rural areas are practically all woodland. Overflow areas along these tributary streams contain soils that are not high quality farmlands, due to the presence of too much sand and not enough clay and silt. DeSoto National Forest, which lies south of Hattiesburg, has considerable area in the flood plains of the streams crossing the forest lands. Open range is practiced in much of the forested area. There are few major highways but sufficient secondary roads cross the sparsely populated rural area to provide ample transportation facilities.

The hard-surfaced highways are on high fills across the flood plains but second-class roads are lower and are frequently flooded.

The tributaries of Leaf River entering the south or right bank below Hattiesburg are very short with small drainage areas, while the left-bank tributaries are relatively long with large drainage areas. Most of these flood plain areas contain soil types that are good for farming. However, frequent flooding along the tributary streams has hindered development of the rural flood plains for agricultural use. Some farm development has occurred in the overflow areas of the larger tributary streams but most of the flood plains remain in woodland. Much of the woodland remains in farm ownership and provides a source of income from timber or pulpwood as well as furnishing range for livestock. If flood control is offered in the future, the flood plain areas have a potential for agricultural development. The hard-surfaced highways usually cross the flood plains on high fills and are seldom inundated; however, second-class roads are at lower elevations and are affected by medium as well as high floods.

Tributaries to the Chickasawhay River are nearly all rural with only a small percentage of the larger tributary flood plains developed for agriculture. The undeveloped areas are woodlands that furnish range for livestock and timber for pulpwood or sawlogs. The soils in the flood plain would make good farmlands if the flood hazard were removed. The principal highways are on high fills through the flood plains but the second-class roads are at lower elevations and are frequently affected by the medium and large floods.

TOTAL FLOOD PLAIN AREA

The areas along the main streams and principal tributaries of the Pascagoula River system that are subject to inundation by a 100-year frequency flood amount ot 464,800 acres, of which 460,700 are rural and 4,100 are urban. The breakdown by streams and reaches is shown in Table 10.

EXISTING FLOOD CONTROL PROJECTS

Corps of Engineers. There is one existing Corps of Engineers flood control project in the basin and one under construction. The existing project is the channel improvement along Sowashee Creek at Meridian. The project under construction is the multiple-purpose Okatibbee Reservoir on Okatibbee Creek near Meridian.

Department of Agriculture. The U. S. Soil Conservation Service maintains an active assistance program with the landowners to conserve the land and water resources of the basin. A watershed work plan for

Table 10

Flood plain areas along main streams and principal tributaries in the Pascagoula River Basin
(Area inundated by flood having a frequency of once in 100 years)

Streams and reaches	Reach number	Stream mile From	Stream mile To	Flood plain area in acres: Rural Cleared	Rural Woods	Rural Subtotal	Urban	Total
PASCAGOULA RIVER & LATERAL TRIBUTARIES								
Pascagoula River	1	5.00	80.70	0	78,600	78,600	-	78,600
Escatawpa River	1	0.00	32.65	100	11,300	11,400	-	11,400
Escatawpa River	2	32.65	55.85	0	5,900	5,900	-	5,900
Subtotal Escatawpa River				100	17,200	17,300	-	17,300
Bluff Creek	1	0.00	15.00	100	2,500	2,600	30[1]	2,630
Red Creek	1	0.00	40.00	600	20,700	21,300	-	21,300
Black Creek	1	0.00	29.00	200	10,500	10,700	-	10,700
Black Creek	2	29.00	78.00	500	21,600	22,100	-	22,100
Subtotal Black Creek				700	32,100	32,800	-	32,800
TOTAL PASCAGOULA R. & LATERAL TRIBUTARIES				1,500	151,100	152,600	30	152,630
LEAF RIVER BASIN								
Leaf River								
McLain	1	0.00	53.37	2,300	47,700	50,000	340[2]	50,340
Hattiesburg, Lower	2	53.37	71.00	900	8,200	9,100	-	9,100
Hattiesburg, Upper	3	71.00	92.67	2,100	8,800	10,900	980[3]	11,880
Collins, Lower	4	92.67	116.03	700	6,400	7,100	-	7,100
Collins, Upper	5	116.03	131.48	1,100	5,400	6,500	-	6,500
Subtotal Leaf River				7,100	76,500	83,600	1,320	84,920
Thompson Creek	1	0.00	19.00	1,300	4,600	5,900	-	5,900
Bogue Homo Creek	1	0.00	52.00	300	15,000	15,300	-	15,300
Tallahala Creek	1	0.00	82.10	4,700	28,000	32,700	480[4]	33,180
Tallahoma Creek	1	0.00	26.33	2,300	5,600	7,900	-	7,900
Tallahoma Creek	2	26.33	29.71	200	400	600	-	600
Subtotal Tallahoma Creek				2,500	6,000	8,500	-	8,500
Oakohay Creek	1	0.00	28.00	400	3,800	4,200	20[5]	4,220
Bowie River & Bowie Creek	1	0.00	24.65	1,500	5,500	7,000	300[6]	7,300
Okatoma Creek	1	0.00	33.00	1,100	9,700	10,800	300[7]	11,100
TOTAL LEAF RIVER BASIN				18,900	149,100	168,000	2,420	170,420
CHICKASAWHAY RIVER BASIN								
Chickasawhay River								
Leakesville	1	0.00	41.00	300	17,700	18,000	-	18,000
Old Avera	2	41.00	73.00	1,000	15,100	16,100	-	16,100
Waynesboro	3	73.00	116.20	7,800	16,200	24,000	300[8]	24,300
Shubuta	4	116.20	126.00	1,400	4,000	5,400	700[9]	6,100
Quitman	5	126.00	143.97	1,400	8,600	10,000	-	10,000
Enterprise	6	143.97	162.40	4,700	7,800	12,500	500[10]	13,000
Subtotal Chickasawhay River				16,600	69,400	86,000	1,500	87,500
Big Creek	1	0.00	11.00	100	2,300	2,400	-	2,400
Bucatunna Creek	1	1.85	12.00	400	4,900	5,300	-	5,300
Bucatunna Creek	2	12.00	61.00	1,700	15,300	17,000	-	17,000
Subtotal Bucatunna Creek				2,100	20,200	22,300	-	22,300
Souinlovey Creek	1	0.00	39.00	500	5,500	6,000	-	6,000
Chunky Creek	1	0.00	32.00	2,100	7,100	9,200	-	9,200
Tallasher Creek	1	0.00	3.00	200	700	900	-	900
Tallahatta Creek	1	0.00	6.00	100	100	200	-	200
Okatibbee Creek	1	0.00	36.73	4,000	9,100	13,100	150[11]	13,250
TOTAL CHICKASAWHAY RIVER BASIN				25,700	114,400	140,100	1,650	141,750
GRAND TOTAL, ENTIRE PASCAGOULA RIVER BASIN				46,100	414,600	460,700	4,100	464,800

[1] Vancleave
[2] McLain, 180 acres; Beaumont, 110 acres; New Augusta, 50 acres.
[3] Hattiesburg, 910 acres; Petal, 50 acres; Harvey, 20 acres.
[4] Laurel
[5] Mize
[6] Hattiesburg
[7] Mt. Olive, 100 acres; Collins, 40 acres; Seminary, 120 acres; Sanford, 40 acres.
[8] Waynesboro
[9] Shubuta
[10] Stonewall
[11] Meridian

the Dry Creek Watershed, Covington County, has been approved for construction. The watershed project, consisting of 3 floodwater retarding structures, 1 multiple-purpose structure for flood prevention and recreation, approximately 14.4 miles of stream channel improvement, and other measures which will provide for the needs of the area, will be constructed under Public Law 566.

Pat Harrison Waterway District. The Pat Harrison Waterway District completed construction of a dam on Flint Creek near Wiggins in Stone County in 1966. The 600-acre reservoir formed by the dam provides storage for water supply for the City of Wiggins, recreation, flood control in the immediate area, and fish and wildlife enhancement.

EVALUATING THE EXTENT AND CHARACTER OF FLOOD DAMAGES

In the following paragraphs, the procedures by which the nature and amount of flood damages in the various reaches were estimated are described and the results are discussed.

General procedures. The extent and character of flood losses in the Pascagoula River Basin were determined from field investigations of the area. Office studies included compilation and analysis of data obtained in the field, determination of flood plain areas, preparation of work data and curves, evaluation of flood losses, computation of average annual damages and adjustment of price levels. Flood damage estimates were based on prices current at the time of the investigation and later adjusted to June 1965 prices.

Field surveys. Special emphasis was placed during the field surveys on areas suffering severe flood losses. Information on losses was obtained directly from persons affected. Data on land-use, cropping practices and losses resulting from sanding or scouring or delays in planting were obtained from county agents, farmers and Soil Conservation Service representatives. Responsible officials were interviewed in regard to the effects of floods on business establishments, railroads, streets, roads and highways, and industries. Data were also obtained on losses due to such items as the cost of rerouting traffic, emergency measures and the removal of debris. Valley cross-sections were taken at typical locations along the flood plains.

Flood damage study. Evaluation of the data obtained in the field indicated that floods along the main streams and principal tributaries in the Pascagoula River Basin cause extensive physical damage to real estate and transportation facilities in both rural and urban areas. Damage to development in urban areas, to farm property other than crops, and to public roads and railroads varies only with the depth of inundation, whereas the magnitude of crop damage is dependent upon flood duration and the season of the flood occurrence as well as on the depth.

Generally, floods are of sufficient duration to destroy all crops inundated, with the exception of the hardier pasture grasses. For that reason, improved pastures presently occupy the major portion of the cleared flood plain land. Few winter crops are grown, because of the frequency of overflows during this season of the year. The greatest crop damage results from floods that occur during the principal growing period, which extends from the planting season in early spring to the end of the harvesting season in December. Late spring floods destroy growing crops and make replanting necessary. Crops that are replanted usually produce inferior yields due to a shortened growing season and exposure to increased insect activity.

Flood damages have been classified as urban, public roads and railroads, crops, and farm property other than crops. Urban losses consist of direct damage to personal and public property, loss of wages to workers, loss of net profit to business concerns, added expenses of emergency protective measures and the cost of removing debris and restoring conditions to normal. Transportation system losses are comprised of direct damages to roads, highways and railroads, cost of rerouting traffic and the cost of providing protection to bridge foundations and road fills. Rural losses result from damage to growing crops and to farm property other than crops, including farm buildings, roads, fences, ditches, livestock, equipment and land. Some other rural losses are the costs of replanting, moving cattle from the flood plain, additional feed required to sustain cattle while the pastures are inundated, and the reduction in crop production due to enforced delay of planting.

Estimates of flood damage were based on delineation of the flood plain areas on aerial photographs and, where available, topographic maps. Information on flood elevations and limits were obtained from local residents and natural and computed flood profiles. Gage records provided the date, stage, and duration of floods.

Estimated average annual flood damages were first computed on the March 1962 price level, current at the time of investigation, and later converted to the June 1965 price level by a comparison of cost indexes. The ratios of these indexes gave the factors used to adjust the damages to the June 1965 price levels. Agricultural damages were divided into two classes: crops and farm property other than crops. The crop damage was adjusted by a comparison of the value of a typical acre of crops in the basin using the different price levels. Table 11 shows the crops, yields, prices and relative weight for each item used in computing this value. The adjustment for "farm property other than crops" was based on the cost index of agricultural machinery and equipment in the Wholesale Price Index published by the Bureau of Labor Statistics, U. S. Department of Labor. "Public roads and railroads" was adjusted by using the cost index for a composite standard mile that

Table 11

Computed value for a typical acre of crops in the Pascagoula River Basin flood plain (1962 farm practices and March 1962 prices)

Item	Percent of crop grown[1]	Unit	Yield per acre	Prices: Unit price[2]	Acre value	Weighted value
Cotton lint	3	pound	510	$ 0.317	$161.67	$ 4.85
Cottonseed (oil seed)	3	ton	0.511	68.46	34.98	1.05
Corn	30	bushel	59	0.99	58.41	17.52
Soybeans	5	bushel	26	2.44	63.44	3.17
Hay	2	ton	2.49	18.08	45.02	0.90
Oats	8	bushel	67[3]	0.61	40.87	3.27
Cover (mixed fertilizer)	4	100 lbs.	7.8	2.10	16.38	0.66
Pasture (livestock)	56	100 lbs.	0.83	20.97	17.41	9.75
Total						41.17

[1] Includes double cropping and joint yield per acre.
[2] Published by U. S. Department of Labor, Wholesale Prices and Price Indexes.
[3] Includes some value derived from grazing.

was compiled by the Bureau of Public Roads and published in Survey of Current Business. The damages to the urban areas were adjusted by using the average ratio of the building cost index and the average hourly wages paid for building construction. The indexes used are shown in Table 12.

Working curves. Working curves were prepared for each reach of the stream for use in estimating flood damages. These curves depict the relationships, with and without projects, between: stage and area inundated; stage and frequency of occurrence; area inundated and frequency of occurrence; crop damage and season of the year; stage and damage; and damage and frequency of occurrence. A typical set of working curves, developed for the Hattiesburg reach, is shown on Figures 13 and 14 and a brief description of each type of curve follows.

Stage-area curve. This relation shows the areas of cleared and wooded land inundated by floods of various stages referenced to the index gage.

Table 12

Price level adjustment indexes for flood damages along streams in the Pascagoula River Basin

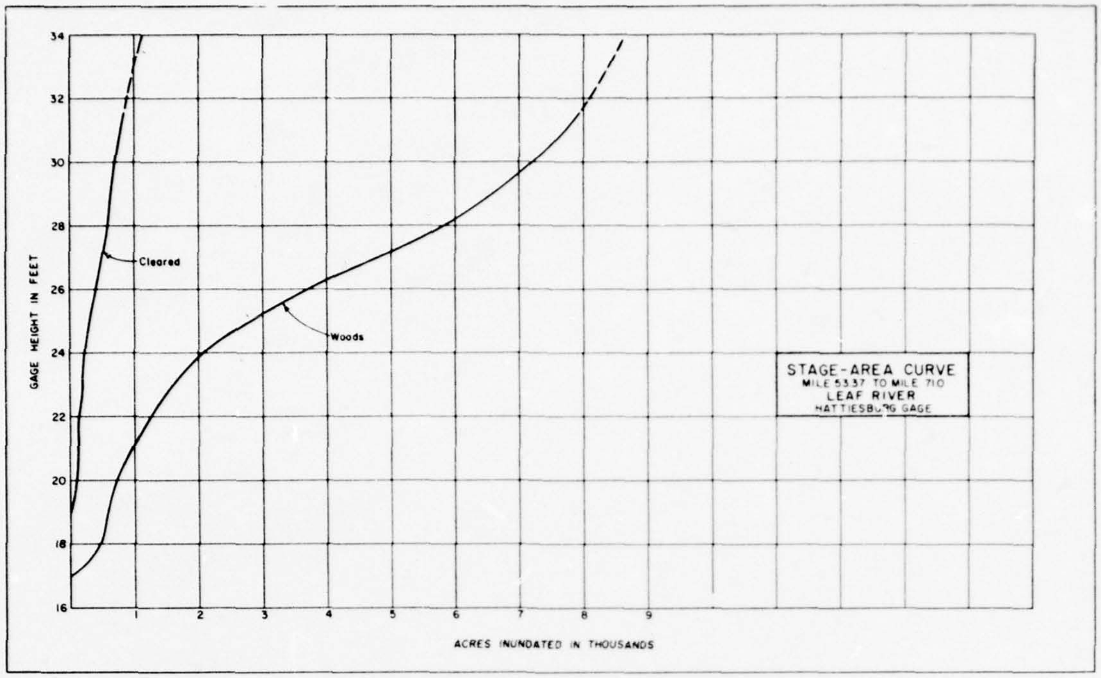
Item	Index March 1962 prices	Index June 1965 prices	Ratio of June 1965 price to March 1962 prices
Crops	41.17[1]	46.72	1.135
Farm property other than crops	109.40[2]	114.70	1.048
Public roads & railroads	97.40[3]	103.20	1.060
Woods range	20.97[1]	23.21	1.107
Urban:			
Labor	3.49[4]	3.91	1.120
Building cost	109.03[5]	118.80	1.090
Average for urban			1.105

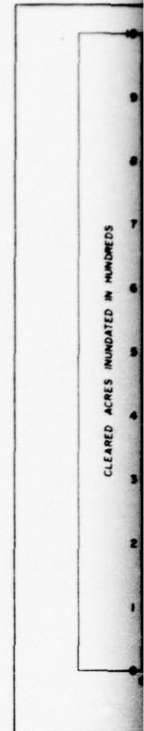
[1]Based on wholesale price index, Bureau of Labor Statistics.
[2]Cost index of agricultural machinery 1957-1959 = 100.
[3]Cost index for composite mile 1957-1959 = 100.
[4]Hourly wage in building construction.
[5]Building cost index 1957-1959 = 100.

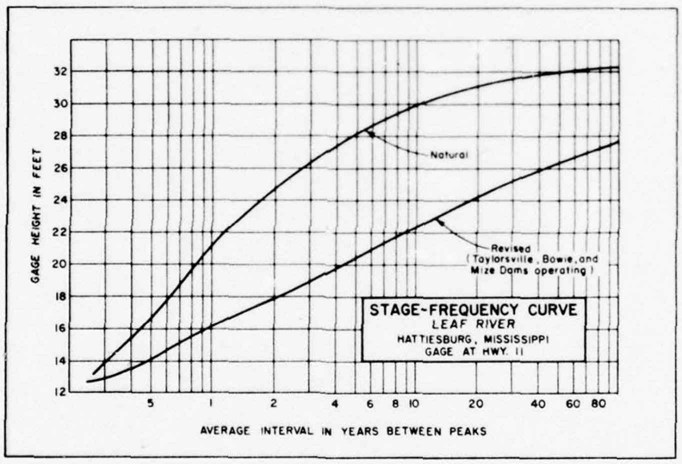
Stage-frequency curve. This curve gives the expected average interval in years between occurrences of any particular stage at the index station.

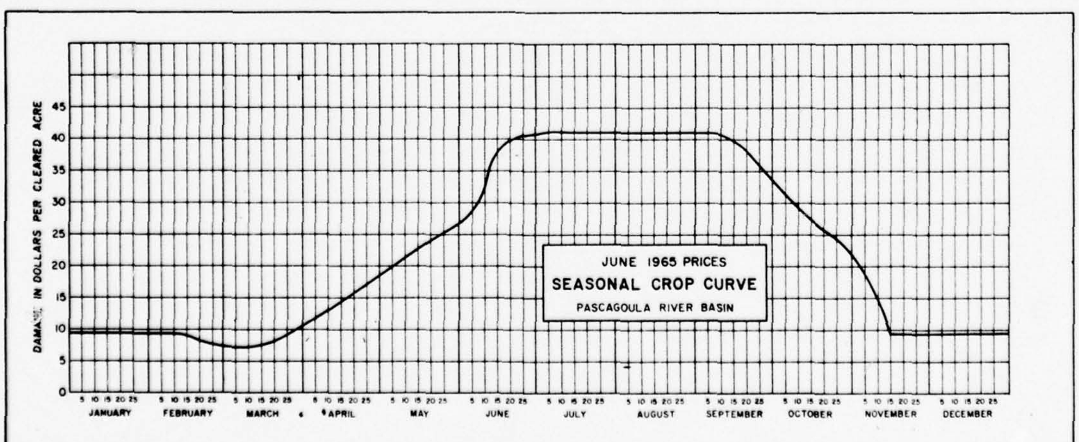
Area-frequency curve. This type curve determines the average area that could be expected to be inundated each year. It was developed from the stage-area and stage-frequency curves; i.e., the area expected to be inundated by a flood reaching a given stage was plotted against the frequency for the stage expressed as average number of occurrences per year.

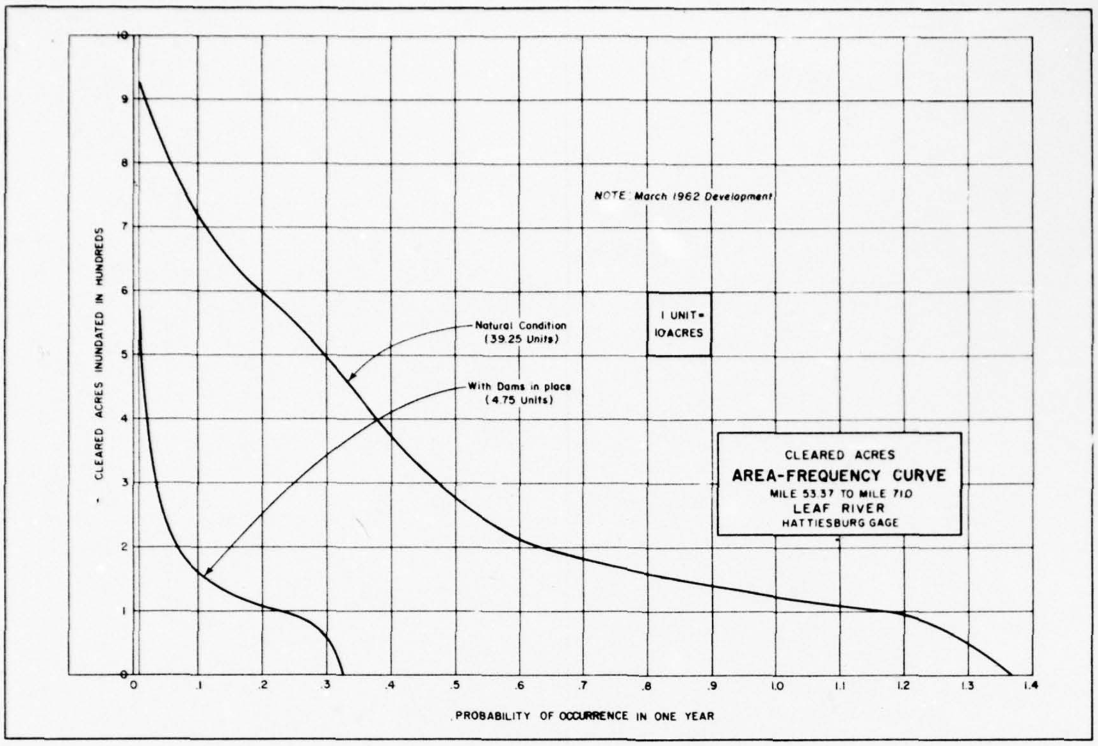
Seasonal-crop curve. This curve displays the estimated damage to crops on a typical cleared flood plain acre on any date throughout the year, should a flood occur. In developing this curve, the costs of planting, cultivating, and harvesting, and the estimated monetary loss due to enforced delay in planting caused by flooding, were evaluated for each crop grown in the flood plain. Thus, the expected value of each crop from inception through harvest was determined. Each crop's value was weighted according to the percentage of the flood plain it occupied and the day-by-day weighted values of all crops growing concurrently were added to form the total seasonal-crop curve. Considered

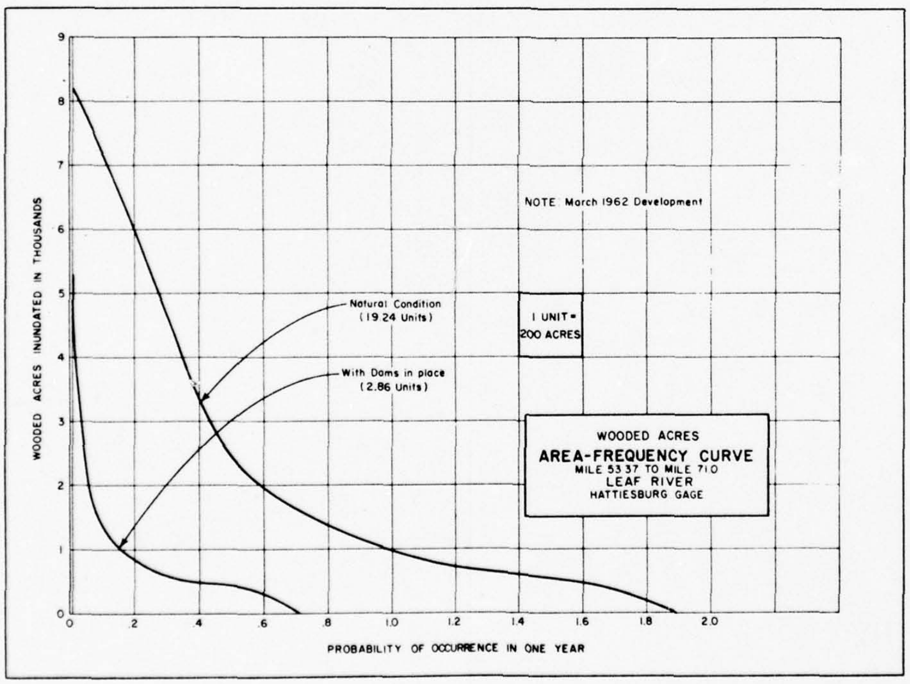

STAGE-AREA CURVE
MILE 53.37 TO MILE 71.0
LEAF RIVER
HATTIESBURG GAGE
GAGE HEIGHT IN FEET
ACRES INUNDATED IN THOUSANDS
Cleared
Woods


CLEARED ACRES INUNDATED IN HUNDREDS


STAGE-FREQUENCY CURVE
LEAF RIVER
HATTIESBURG, MISSISSIPPI
GAGE AT HWY. 11
GAGE HEIGHT IN FEET
AVERAGE INTERVAL IN YEARS BETWEEN PEAKS
Natural
Revised
(Taylorsville, Bowie, and Mize Dams operating)


JUNE 1965 PRICES
SEASONAL CROP CURVE
PASCAGOULA RIVER BASIN
DAMAGE IN DOLLARS PER CLEARED ACRE
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER





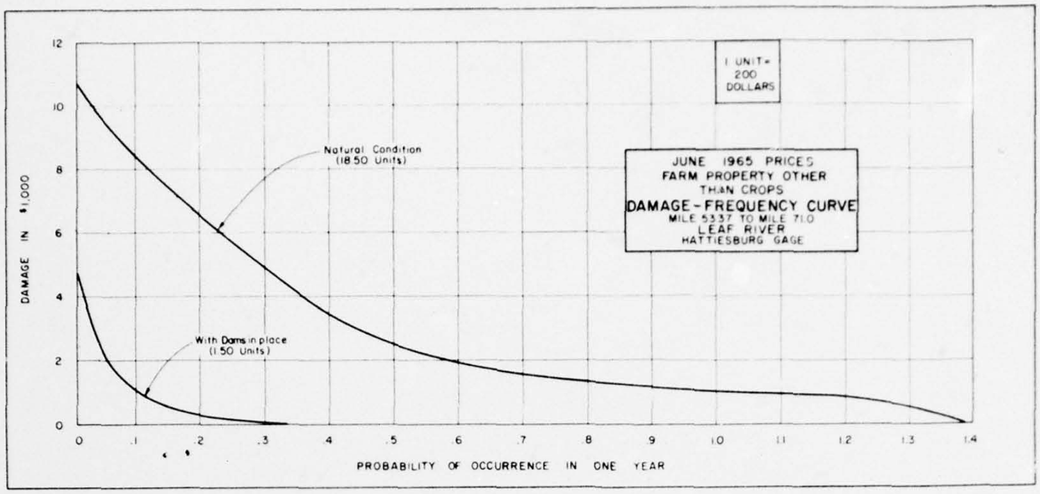
NOTE:

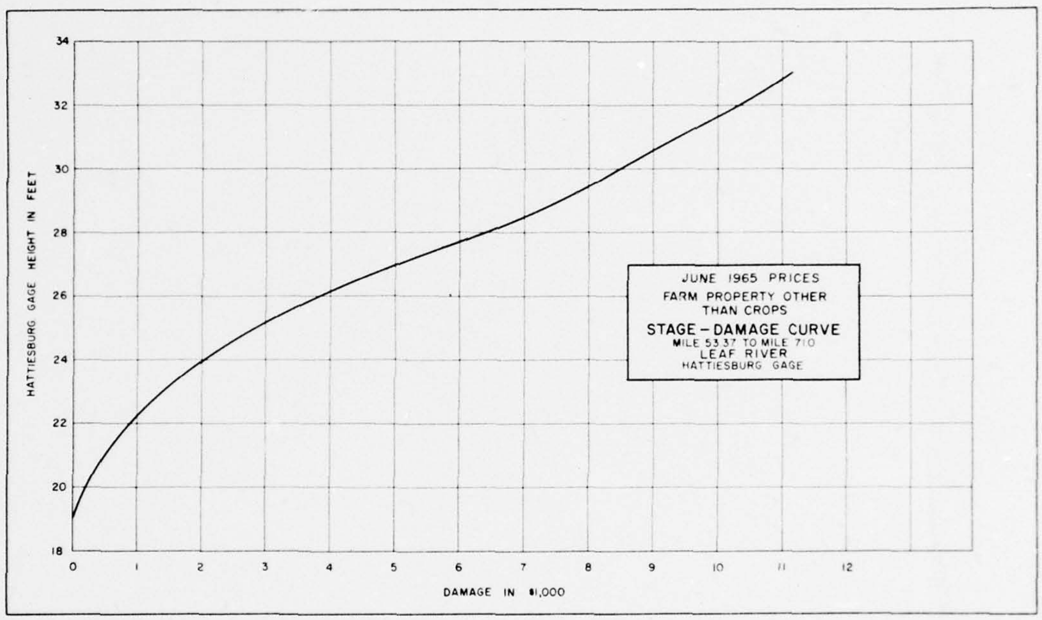
Dams in place are Taylorsville, Bowie and Mize.

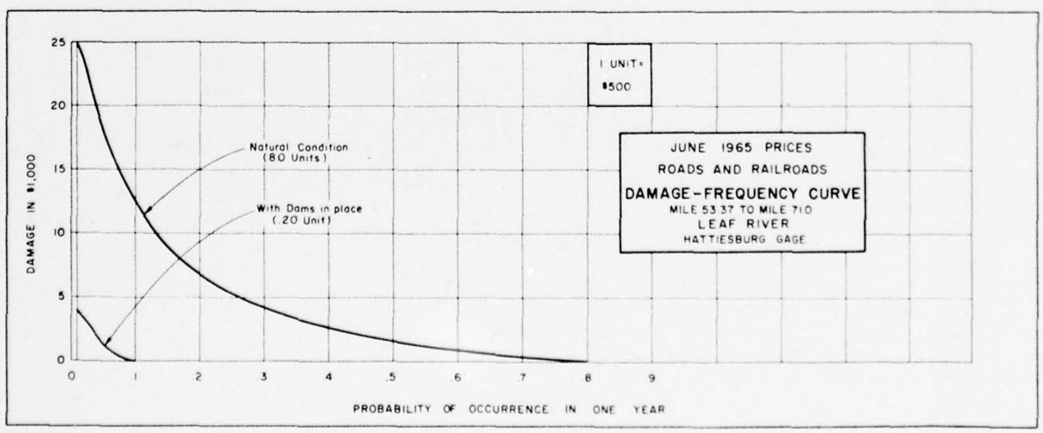
PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

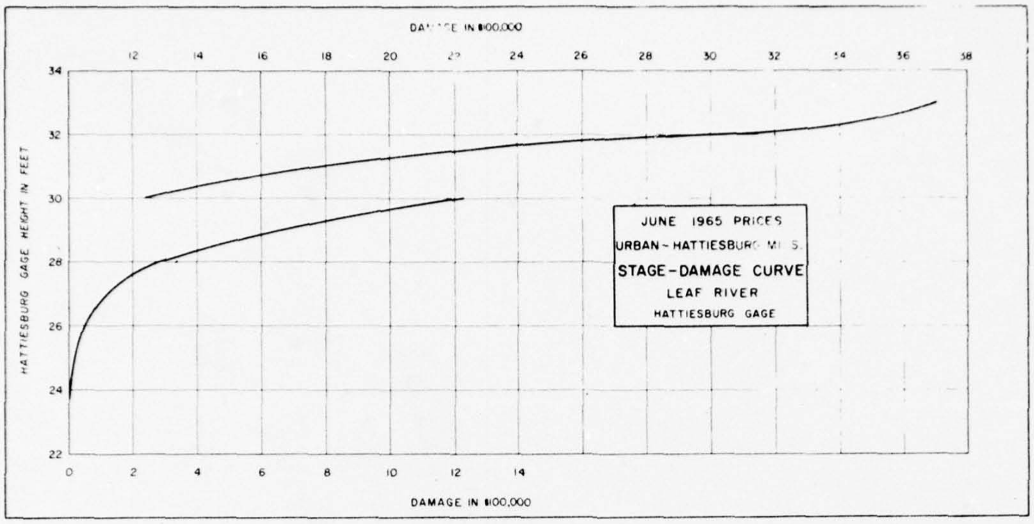
TYPICAL FLOOD DAMAGE CURVES

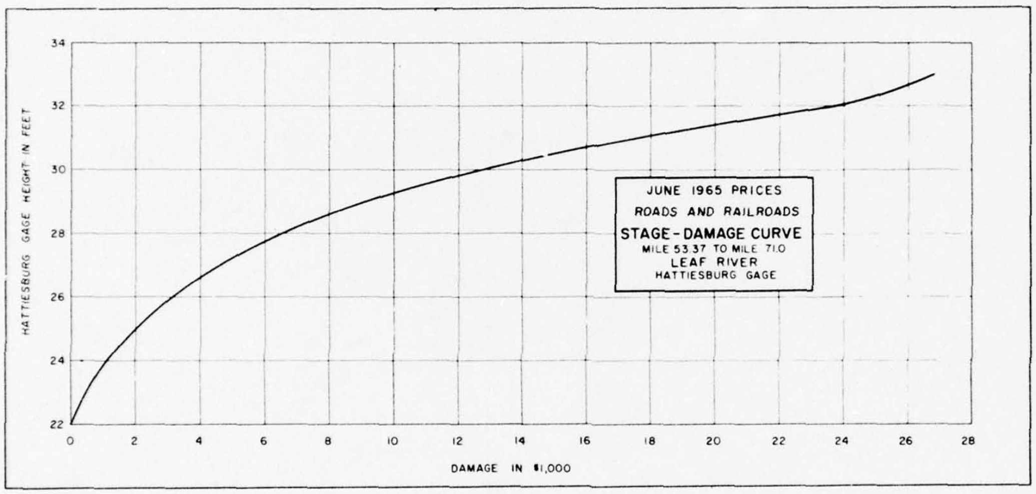
FIGURE 13

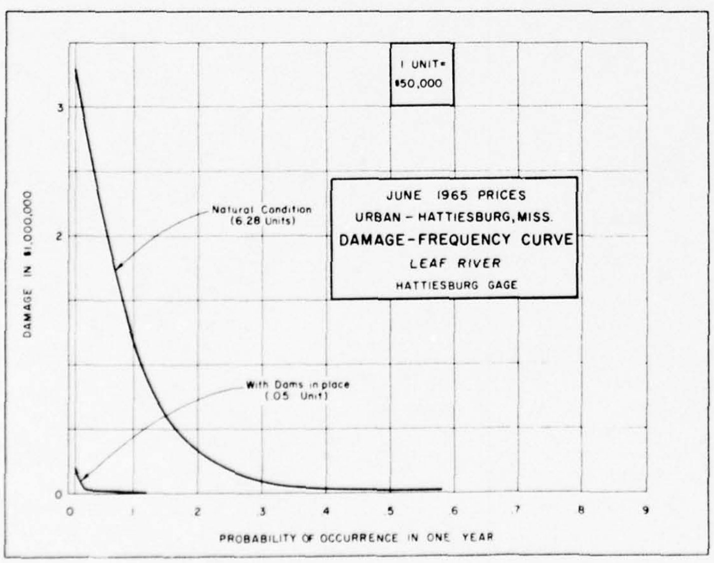

1 UNIT= 200 DOLLARS
Natural Condition (18.50 Units)
With Dams in place (1.50 Units)
JUNE 1965 PRICES
FARM PROPERTY OTHER THAN CROPS
DAMAGE-FREQUENCY CURVE
MILE 53.37 TO MILE 71.0
LEAF RIVER
HATTIESBURG GAGE
DAMAGE IN $1,000
PROBABILITY OF OCCURRENCE IN ONE YEAR


JUNE 1965 PRICES
FARM PROPERTY OTHER THAN CROPS
STAGE-DAMAGE CURVE
MILE 53.37 TO MILE 71.0
LEAF RIVER
HATTIESBURG GAGE
HATTIESBURG GAGE HEIGHT IN FEET
DAMAGE IN $1,000


1 UNIT= $500
Natural Condition (80 Units)
With Dams in place (.20 Unit)
JUNE 1965 PRICES
ROADS AND RAILROADS
DAMAGE-FREQUENCY CURVE
MILE 53.37 TO MILE 71.0
LEAF RIVER
HATTIESBURG GAGE
DAMAGE IN $1,000
PROBABILITY OF OCCURRENCE IN ONE YEAR







NOTE
Dams in place are Taylorsville, Bowie and Mize

PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

TYPICAL FLOOD DAMAGE CURVES

FIGURE 14

in the development of this curve was the fact that floods in this basin generally are of sufficient duration to destroy all crops except pasture grasses.

Stage-damage curve. Separate curves of this type were prepared for urban areas, roads and railroads, and farm property other than crops, with no seasonal variation in damage.

Damage-frequency curve. This curve, a combination of the stage-damage and stage-frequency curves, was drawn for urban areas, roads and railroads, and farm property other than crops. A curve for each type of damage was developed by plotting the damage in dollars against the average frequency of occurrence in number of times per year.

The working curves provided a means of converting the various types of damage to an average annual basis. Average annual damage to urban areas, roads and railroads, and farm property other than crops was determined by measuring the area under the corresponding damage-frequency curve. Average annual crop damage was determined by use of a listing of the known floods, including date of occurrence and stage reached, and through use of stage-area curves and the seasonal-crop curve. Each flood was evaluated by entering the stage-area curve with the stage reached by the flood and multiplying the cleared acres inundated by the value per cleared acre on the date that the flood occurred. The total crop damage caused by all floods of record divided by the number of acres covered by the floods of record resulted in the estimated unit damage per acre to crops, $11.80. The summation of average annual damages to crops, roads and railroads, and farm property other than crops for each reach gave the total rural damage for the stream.

RURAL FLOOD DAMAGES

The flood plain affected in the damage reaches shown on Figure 12 and listed in Table 10 contains about 464,800 acres, of which 46,100 acres or about 10 percent are cleared for agricultural uses. Although the wooded acreage in the flood plain greatly exceeds the number of cleared acres, damages to cleared land and associated improvements comprise a considerably larger part of the total rural damages. Wooded lands are damaged only slightly, due to the fact that the type of timber generally existing in the bottomlands is well-adapted to present flood conditions. The major portion of damage resulting from inundation of these lands is comprised of loss of woodland grazing. Crop damage results from flooding during any season of the year, but the greatest damage occurs to growing or unharvested crops during the period extending from late spring to late fall. The preparation of the soil necessary to plant row crops leaves the soil in a loose and easily eroded condition. Pastures, on the other hand, are generally flood-hardy and their sod

tends to mat and prevent erosion. Floods along the streams also injure the land by sanding and scouring. They damage fences, field roads, drainage ditches, buildings located in the flood plain, and farm equipment. The major losses accruing to roads and railroads result from damage to bridges, road fills and surfaces. The costs of rerouting traffic and providing emergency protective measures for bridges and fills are examples of additional road and railroad flood losses.

The estimated average annual rural damages along the reaches of the main streams and principal tributaries in the Pascagoula River Basin are shown in Table 13. The total amount, based on March 1962 development and June 1965 prices, is $1,279,900, of which $891,800 is agricultural and $388,100 is to roads and railroads.

The February 1961 flood caused an estimated $2,097,000 damage to these rural areas. A 100-year flood occurring in the crop growing season would cause an estimated damage of $4,064,100; in the winter, it would cause an estimated damage of $2,406,100.

URBAN FLOOD DAMAGES

Urban flood damages are the losses that are experienced by property and businesses in the urban places that are located in the flood plains. Floods affect residential, commercial, and industrial development, damaging both private and public property and inflicting losses from restricted business operations as well as from interfering with transportation.

The 17 affected cities and towns in the basin had a total damage of $5,337,000 caused by the February 1961 flood. The estimated average annual flood damage to these urban places, based on March 1962 development and June 1965 prices, amounts to $680,700, as shown in Table 13.

The following paragraphs describe briefly the affected urban areas and their estimated flood damages based on March 1962 development and June 1965 prices.

McLain on Leaf River. McLain is located on the right bank of Leaf River at river mile 14.6. It is a small town on the outer edge of the flood plain and is affected by medium and high flood stages. The flood of February 1961 affected 4 churches, 104 dwellings, and 20 retail and service establishments. During the flood the water inundated about 180 acres of urban development. The deepest stages were 5 to 6 feet over the ground, resulting in a damage estimated at $113,000. Average annual flood damage to McLain is estimated at $3,100.

Beaumont on Leaf River. Beaumont is located on the right bank of Leaf River at river mile 29.6. This small town is affected by medium

and high flood stages. The February 1961 flood reached 32.8 feet on the Beaumont river gage and affected 58 dwellings, 5 retail and service establishments and a large sawmill. There are about 110 acres in the town subject to inundation. Flood damage begins at 25 feet on the gage and a flood equal to that of February 1961 would cause about $53,000 damage. The average annual flood damage for the town is estimated at $7,300.

New Augusta on Leaf River. New Augusta is located on the edge of the flood plain about a mile from the right bank of Leaf River at mile 42.0. This small town, which is affected by medium and high flood stages, has about 50 acres of urban area development subject to inundation by floods. The February 1961 flood affected 8 small service and retail businesses and 36 dwellings. Damage begins at a stage of 27 feet on the Beaumont river gage and a stage equal to the February 1961 flood would cause $100,000 damages. The average annual flood damage is estimated at $10,600.

Hattiesburg on Leaf River. The City of Hattiesburg has urban development in the flood plains along the right banks of Bowie and Leaf Rivers at their junction at mile 70.77 on the Leaf River. Flood damage begins at a stage of 22 feet on the Leaf River gage. The 30-year flood of February 1961 reached a stage of 31.53 feet and inundated 300 acres along the Bowie River and 980 acres along the Leaf River, making a total of 1,280 acres containing 1,930 dwellings and 220 businesses. The business establishments are widely scattered and consist of 2 railroad yards, 4 large public schools, a trailer park, 2 trucking companies, a core-drilling equipment company, 2 concrete pipe and block manufacturing concerns, numerous wholesale and retail businesses, and many service establishments. The February 1961 flood caused a flood loss of $2,450,000 in Hattiesburg, including the damage along the Bowie River. Average annual flood damage is $314,000.

Petal on Leaf River. On the left bank of Leaf River near the mouth of Bowie River is the unincorporated urban community of Petal, a suburb of Hattiesburg. The livelihood of Petal depends largely on the local residents being employed in Hattiesburg. The February 1961 flood inundated about 50 urban acres and affected 133 dwellings and 41 businesses. The businesses consist principally of one sawmill, a cotton gin, a dairy processing plant, an animal food plant, and many retail and service establishments. A flood stage of 31.53 feet on the river gage, which is equal to that reached in February 1961, would cause damages of about $800,000 in Petal. The average annual flood damages are estimated at $105,400.

Harvey on Leaf River. The community of Harvey on the left or east bank of Leaf River across from Hattiesburg, has extended the urban development into the narrow flood plain. Floods in this community affect

7 low-priced dwellings and 5 small service business establishments. Extremely high stages inundate the 20-acre developed area to a depth of 6 feet. A flood stage equal to that of February 1961 would cause about $15,000 damage and the estimated average annual flood damage is $1,400.

Laurel on Tallahala Creek. The City of Laurel, on the right bank of Tallahala Creek, has a 480-acre flood plain containing 660 dwellings and 30 businesses that are principally service type but include one large plant that manufactures pressed-board from wood pulp. Flood damage begins at a stage of about 13 feet on the local gage and, with a stage of 25.4 feet, the equivalent of the 100-year flood, the damage would be about $900,000. The average annual urban flood damages are $74,000, but these losses would be greatly reduced by the operation of the proposed Tallahala Reservoir. This project was recommended in an interim report on the Pascagoula River Comprehensive Basin Study submitted by the Corps of Engineers in April 1966 and is now pending authorization by the Congress.

Vancleave on Bluff Creek. The town on Vancleave is located on both banks of Bluff Creek about 15 miles northwest of Pascagoula. However, only the urban development on the left or north bank is affected by floods. High water inundates about 30 urban acres and affects 12 dwellings and 5 retail stores or service establishments. Also a plant that manufactures purses and employs 40 to 50 workers is located on the left bank of Bluff Creek about 2 miles downstream from Vancleave. Floodwaters from Bluff Creek inundate sections of the town and the purse factory to a depth of 5 to 6 feet. Flood damage begins when the stage goes above bankful, and a flood stage of 6 feet above bankful would cause an estimated damage of $120,000. The average annual flood damage to the community is estimated to be $8,600.

Mize on Oakohay Creek. The town of Mize, located about 24 miles above the mouth of Oakohay Creek, has urban development in 20 acres of the narrow flood plain. The 30 businesses affected include a plant that manufactures raincoats, an egg-processing plant, a large supermarket, a post office, retail stores and service establishments. There are 21 dwellings in the flood plain. Flood damages begin at 13 feet on the stream gage and at 16.5 feet, which is the estimated 100-year-frequency stage, the flood damage would be about $290,000. Average annual flood damage to the town is estimated at $55,000.

Sanford on Okatoma Creek. At Sanford, a 100-year-frequency flood on Okatoma Creek would inundate about 40 acres of urban area. The affected area contains 15 dwellings, a public school, 2 churches and 6 retail stores or service establishments. Floods begin to damage the urban development at stages 2 to 3 feet above bankful, and a flood stage of 5 feet overbank, which is equal to the February 1961 flood,

would cause a damage of about $40,000. On an average, floods cause $15,600 damage annually in the community.

Seminary on Okatoma Creek. Seminary is a small town with about 120 urban acres in the flood plain of Okatoma Creek. Floods affect 18 dwellings, 2 churches, and 3 service establishments. A flood stage equal to that of February 1961 would cause about $18,000 damage. The village has an estimated average annual flood damage of $10,400.

Collins on Okatoma Creek. The town of Collins has about 40 acres or urban development extending into the flood plain of Okatoma Creek. The February 1961 flood waters, which were 5 to 6 feet deep in some places, affected 9 dwellings and 7 retail or service establishments. A flood stage equal to the February 1961 flood would cause about $30,000 damage. The average annual flood damage at Collins is estimated at $21,700.

Mount Olive on Okatoma Creek. Mount Olive, near the headwaters of Okatoma Creek, has about 100 acres of urban area in the flood plain. The February 1961 flood reached a stage of 16.2 feet on the stream gage and affected 31 houses and 5 small businesses, principally service establishments. Flood stages above 12 feet on the gage begin to inundate the urban area and a stage of 16.2 feet (February 1961) would cause a damage of about $27,000. Average annual flood damage to the urban community is estimated at $14,800.

Waynesboro on Chickasawhay River. There are about 300 acres of urban area affected by high flood stages at Waynesboro, about mile 95 on the left bank of the Chickasawhay River. The flood of February-March 1961, which reached an estimated stage of 47.7 feet on the river gage, affected 86 dwellings and 20 businesses which are principally retail and service establishments. Floods start to damage the urban development at 42 feet on the gage and at a stage of 48 feet the damage is estimated at $100,000. The average annual flood damages to the town are estimated at $8,100.

Shubuta on Chickasawhay River. The small town of Shubuta is located in the outer part of the Chickasawhay River flood plain at river mile 117. The greater part of the town was inundated by the February 1961 flood, which reached a stage of 45.0 feet on the river gage. Water was from 6 to 7 feet deep in the developed areas of town. Floods affect 110 dwellings and 16 businesses which include 2 small sawmills, a charcoal plant, and retail and service establishments. Flood damage begins at 34.0 feet on the river gage and a flood stage of 46.0 feet would cause $150,000 damage. Average annual damage is estimated at $18,900.

Stonewall on Chickasawhay River. Stonewall is located on the left bank of the Chickasawhay River at river mile 158 in the outer part of the flood plain. For its livelihood, this rural village depends mostly on a textile mill that employs from 300 to 500 persons. During the highest known flood, that of April 1900, water was 6 feet deep in the basement of the mill. There are 500 acres of urban area in the town subject to inundation. High flood stages would affect 118 dwellings and 15 small service and retail establishments. The April 1900 flood reached an estimated stage of 37.2 feet on the Enterprise river gage and a flood of this size would cause a damage of about $169,000. The average annual flood damage to the urban development of Stonewall is $5,500.

Meridian on Okatibbee Creek. Meridian is on the east bank of Okatibbee Creek about 23 miles above its mouth. The flood plain in this vicinity is relatively narrow. Floods along the creek affect 3 small service establishments and 14 dwellings that are within the 150 urban acres subject to inundation. Urban flood damages are caused by flood stages above 22.0 feet on the Old Highway 80 gage. Stages 10 feet over bankful would cause about $100,000 damage to the urban community. The estimated average annual flood damage to Meridian's urban development is $4,800, with the nearly completed Okatibbee Dam in operation.

TOTAL FLOOD DAMAGES

The total average annual flood damages along the main streams and principal tributaries in the Pascagoula River Basin, based on March 1962 development and June 1965 prices, is estimated to be $1,960,600, of which $1,279,900 is rural and $680,700 is urban. A summary of annual flood damages by type and stream reach is given in Table 13.

Table 13

Average annual flood damages along main streams and principal tributaries in the Pascagoula River Basin (March 1962 development and June 1965 prices.)

Streams and reaches	Reach No.	Stream mile From	Stream mile To	Crops	Other than crops	Woods range	Subtotal	Roads and railroads	Urban	Total
PASCAGOULA RIVER & LATERAL TRIBUTARIES										
Pascagoula River	1	5.00	72.75	$ 0	$ 86,000	$ 52,900	$138,900	$ 3,600	$ 1,500	$ 144,000
Escatawpa River	1	0.00	32.65	1,000	200	2,700	3,900	10,500	0	14,400
Escatawpa River	2	32.65	55.85	0	0	1,000	1,000	2,900	0	3,900
Subtotal Escatawpa River				1,000	200	3,700	4,900	13,400	0	18,300
Bluff Creek	1	0.00	15.00	300	100	800	1,200	1,800	8,600[1]	11,600
Red Creek	1	0.00	40.00	4,800	1,500	3,800	10,100	6,400	0	16,500
Black Creek	1	0.00	29.00	3,600	900	4,300	8,800	0	0	8,800
Black Creek	2	29.00	78.00	5,200	1,400	6,000	12,600	37,100	0	49,700
Subtotal Black Creek				8,800	2,300	10,300	21,400	37,100	0	58,500
TOTAL PASCAGOULA RIVER & LATERAL TRIBUTARIES				14,900	90,100	71,500	176,500	62,300	10,100	248,900
LEAF RIVER BASIN										
Leaf River										
McLain	1	0.00	53.37	21,100	11,800	13,900	46,800	32,800	21,000[2]	100,600
Hattiesburg, lower	2	53.37	71.00	5,200	3,700	1,400	10,300	4,000	420,800[3]	435,100
Hattiesburg, upper	3	71.00	92.67	11,100	7,300	1,700	20,100	10,200	0	30,300
Collins, lower	4	92.67	116.03	2,300	1,900	600	4,800	7,700	0	12,500
Collins, upper	5	116.03	131.48	3,400	2,600	500	6,500	0	0	6,500
Subtotal Leaf River				43,100	27,300	18,100	88,500	54,700	441,800	585,000
Thompson Creek	1	0.00	19.00	26,000	21,200	3,400	50,600	32,200	0	82,800
Bogue Homo Creek	1	0.00	52.00	2,800	900	3,300	7,000	15,800	0	22,800
Tallahala Creek	1	0.00	82.10	49,500	20,900	10,300	80,700	29,300	74,000[4]	184,000
Tallahoma Creek	1	0.00	26.33	59,000	35,200	3,700	97,900	12,400	0	110,300
Tallahoma Creek	2	26.33	29.71	9,600	5,500	600	15,700	0	0	15,700
Subtotal Tallahoma Creek				68,600	40,700	4,300	113,600	12,400	0	126,000
Oakohay Creek	1	0.00	28.00	12,000	4,700	3,700	20,400	8,700	55,000[5]	84,100
Bowie River & Bowie Creek	1	0.00	24.65	12,400	7,100	1,400	20,900	42,800	[6]	63,700
Okatoma Creek	1	0.00	33.00	17,500	6,100	3,800	27,400	15,500	62,500[7]	105,400
TOTAL LEAF RIVER BASIN				231,900	128,900	48,300	409,100	211,400	633,300	1,253,800
CHICKASAWHAY RIVER BASIN										
Chickasawhay River										
Leakesville	1	0.00	41.00	4,100	1,700	8,000	13,800	6,800	0	20,600
Old Avera	2	41.00	73.00	5,700	3,100	2,300	11,100	4,300	0	15,400
Waynesboro	3	73.00	116.20	24,600	15,700	1,500	41,800	8,300	8,100[8]	58,200
Shubuta	4	116.20	126.00	10,300	5,200	800	16,300	11,000	18,900[9]	46,200
Quitman	5	126.00	143.98	9,800	4,600	1,500	15,900	9,800	0	25,700
Enterprise	6	143.97	162.40	23,000	12,600	1,900	37,500	1,800	5,500[10]	44,800
Subtotal Chickasawhay R.				77,500	42,900	16,000	136,400	42,000	32,500	210,900
Big Creek	1	0.00	11.00	2,400	1,000	800	4,200	6,000	0	10,200
Bucatunna Creek	1	1.85	12.00	1,100	500	400	2,000	800	0	2,800
Bucatunna Creek	2	12.00	61.00	15,900	7,000	5,200	28,100	4,800	0	32,900
Subtotal Bucatunna Creek				17,000	7,500	5,600	30,100	5,600	0	35,700
Souinlovey Creek	1	0.00	39.00	14,200	8,400	4,400	27,000	8,300	0	35,300
Chunky Creek	1	0.00	32.00	20,600	13,300	1,800	35,700	27,300	0	63,000
Tallasher Creek	1	0.00	3.00	2,000	1,400	200	3,600	2,700	0	6,300
Tallahatta Creek	1	0.00	6.00	100	100	300	500	500	0	1,000
*Okatibbee Creek	1	0.00	36.73	40,100	20,800	7,800	68,700	22,000	4,800[11]	95,500
TOTAL CHICKASAWHAY R. BASIN				173,900	95,400	36,900	306,200	114,400	37,300	457,900
GRAND TOTAL, ENTIRE PASCAGOULA RIVER BASIN				420,700	314,400	156,700	891,800	388,100	680,700	1,950,600

* With Okatibbee Dam in place.
[1] Vancleave.
[2] McLain, $3,100; Beaumont, $7,300; New Augusta, $10,600.
[3] Hattiesburg, $314,000 (includes damages on Bowie River; see footnote [6]); Petal, $105,400; Harvey, $1,400.
[4] Laurel.
[5] Mize.
[6] Hattiesburg. All damages are included with Leaf River in [3].
[7] Mt. Olive, $14,800; Collins, $21,700; Seminary, $10,400; Sanford, $15,600.
[8] Waynesboro.
[9] Shubuta.
[10] Stonewall
[11] Meridian.

PART B — FLOOD CONTROL BENEFITS

GENERAL

This part presents estimated flood control benefits from the reduction of flooding due to operation of the major reservoir projects that are included in the proposed early-action program: Taylorsville, Bowie, Mize, and Harleston. These benefits stem from reduction in flood losses to existing and future developments of the flood plains and from changes in land use. Reduced flood loss benefits were derived by obtaining the difference in damages that would occur with and without the projects. Change in land use benefits would be realized through changing of flood plain cropping practices to include higher valued crops and from clearing wooded bottomland and converting to a more productive use.

FLOOD LOSSES PREVENTED

The benefits due to flood damage prevented were computed, using the working curves described in Part A of this section. The difference in crop damage (acres inundated x seasonal unit damage for each flood) with and without the project constitutes the benefit to crops. All other benefits attributable to losses prevented were estimated by using the damage-frequency curves reflecting damages with and without the projects. These benefits are based on the development expected to prevail at the assumed time of project installation (1975).

CHANGED LAND USE

Flood control improvements would reduce the depths and frequencies of flooding and permit the bottomlands to be used more intensively. For rural areas, benefits are derived from changing the cropping practices on presently cleared flood plain land and from changing wooded land to cleared land.

Change of cropping practice benefits on presently cleared land are the result of producing higher value crops. Agricultural questionnaires obtained from Department of Agriculture personnel, county officials and farmers in the area provided pertinent data on current yields, cost of production and percentage of flood plain area planted to each crop. These data were used to estimate yields, cost of production and land use under flood-free conditions. The weighted net productive values of a typical flood plain acre under present and flood-free conditions were computed as shown in Table 14. Since the flood control project would not provide complete protection from flooding, it was assumed that the change in land use under flood-free conditions would

Table 14

Net per acre production value of presently cleared land along the Leaf River (1962 farm practices and March 1962 prices)

Crop	Gross value	Cost to produce crop	Net productive value	Under Present conditions: Relative weight %	Under Present conditions: Weighted value (dollars)	With complete flood control: Relative weight %	With complete flood control: Weighted value (dollars)
SUMMER CROPS							
Corn	$ 64.00	$ 41.00	$ 23.00	20	4.60	29	6.67
Cotton	195.00	106.00	89.00	4	3.56	7	6.63
Improved pasture	44.00	20.00	24.00	56	13.44	52	12.48
Unimproved pasture	14.00	6.00	8.00	13	1.04	0	0
Truck	216.00	103.00	113.00	1	1.13	2	2.26
Hay	41.00	33.00	8.00	4	0.32	5	0.40
Soybeans	84.00	42.00	42.00	2	0.84	5	2.10
Idle	-	-	-	-	-	-	-
Subtotal				100	24.93	100	30.14
WINTER CROPS							
Oats	46.00	32.00	14.00	14	1.96	27	3.78
Rye	29.00	16.00	13.00	2	0.26	10	1.30
Cover	20.00	15.00	5.00	3	0.15	7	0.35
Improved pasture	18.00	11.00	7.00	56	3.92	52	3.64
Unimproved pasture	10.00	4.00	6.00	13	0.78	0	0
Truck	225.00	100.00	125.00	2	2.50	3	3.75
Idle	-	-	-	10	0	1	0
Subtotal				100	9.57	100	12.82
GRAND TOTAL					34.50		42.96
Increase per acre in net productive value							8.46

be reduced in proportion to the degree of protection provided. The degree of protection was expressed as the reduction in total present annual crop damages divided by the total present annual crop damages. The change in land use benefits were also reduced for damages remaining. The net benefits per cleared acre multiplied by the total number of cleared flood plain acres gave the total benefits from changing cropping practices.

Change in land use benefits were also determined for converting woodland to cropland. The increase in net productive value of a typical acre so changed, under flood-free conditions, was estimated as shown in Table 15. The actual benefits are equal to this increase less the damage to the higher valued crops that would be grown.

Table 15

Estimate of the increase in net productive value resulting from converting an acre of woodland to cropland along the Leaf River (1962 farm practices and March 1962 prices)

FIRST COST FOR CONVERSION	
Clearing of land	$ 100.00
Lateral drainage	40.00
Field roads, fences, etc.	35.00
Total first cost	175.00
ANNUAL CHARGES	
Interest - 5 percent	8.75
Amortization - 0.00478 (50-year life)	0.83
Total annual charge	9.58
PRESENT NET PRODUCTIVE VALUE	
Value of timber growth	9.00
Maintenance and other costs	1.50
Present net value	7.50
INCREASE IN NET PRODUCTIVE VALUE	
Net productive value of cropland	42.96
Less present net productive value	7.50
Less annual charges for conversion	9.58
Increase in net productive value	25.88

The number of additional acres that would be changed with the projects in place was related to total wooded acres in the flood plain, degree of protection offered by the projects, and information contained in the agricultural questionnaires. Data from Appendix E and from "Agricultural Economic Base Study of the Pascagoula River Basin Study Area", by the Department of Agriculture, were also used in this determination.

Based on the information above, it is estimated that approximately 17,600 acres would be changed in the ten years following the assumed time of project installation (1975-1985). This ten-year growth period was taken into account and discounted in calculating benefits for 1975 development. The number of acres to be changed and benefits from changed land use were adjusted for conditions expected to prevail at the assumed time of project completion (1975).

ADJUSTMENT OF BENEFITS FOR CHANGE IN PRICE LEVEL

In the process of investigation, the estimated flood control benefits were first computed on the March 1962 price level and then converted to the June 1965 price level. The average annual benefits were later brought up to the January 1966 price level used in presenting project costs. In this report each class of benefit was adjusted by a comparison of cost indexes or values corresponding to March 1962, June 1965, and January 1966 prices. The ratios of these indexes were the factors used to update the benefits. Agriculture benefits were divided into two classes: "crops" and "farm property other than crops." The adjustment for "reduced crop damage" was based on the wholesale price index (Bureau of Labor Statistics). The benefits derived from expected change in land use were adjusted by a comparison of the net value of a typical flood plain acre with and without flood control, using the different price levels. The adjustment for "farm property other than crops" was based on the cost index of agricultural machinery and equipment in the Wholesale Price Index published by the Bureau of Labor Statistics, U. S. Department of Labor. "Public roads and railroads" was adjusted by using the cost index for a composite standard mile that was compiled by the Bureau of Public Roads and published in the Survey of Current Business. The benefits to the urban areas were adjusted by using the average of two index ratios, building cost and average hourly wages paid for building construction.

FUTURE FLOOD CONTROL BENEFITS

Economic growth in the Pascagoula River Basin is expected to continue with the increased industrialization of the southeastern United States. This basin has an ample potential water supply, many natural resources and a mild climate, all of which tend to attract new industries and

encourage expansion of those presently existing. Increased employment opportunities due to industrial development and increased population will create a need for more agricultural products, housing, and service industries causing a continued expansion of urban and rural development in the flood plain.

In evaluating future rural damages prevented, a factor judged to be indicative of the agriculture growth trend in the area was used. Projected agricultural cash receipts presented in Appendix E were used as an indicator of future rural benefits. This indicator was used to reflect increased yields, net income and flood plain development.

To evaluate future urban damages prevented, various factors relating to growth without the projects in place were considered. They were: the type of property occupying the flood plains; the areas in and out of the flood plain available for construction of residences, businesses, and industrial development; past and present growth patterns; the relationship of transportation facilities to these areas; and maps and other information regarding existing and proposed zoning and land use. After considering these factors and the economic growth projections presented in Appendix E, projected urban population was judged to be indicative of future urban flood plain development. An estimate of the benefits from reduction in damage to future development was determined by applying the indicator to current flood control benefits using a 100-year project life (1975-2075), assuming full development in 50 years and using 3.25 percent interest.

TOTAL FLOOD CONTROL BENEFITS

The total average annual flood control benefits (during the 100-year project life, 1975-2075) that would result from operation of the proposed flood control system above Hattiesburg - Taylorsville, Bowie, and Mize Reservoirs - and the proposed Harleston Reservoir are estimated at $2,501,000, based on January 1966 prices. The annual benefits for the initial 1975 development are $1,539,100 and for future development $961,900. No credit is included for enhancement of land in urban areas in the flood plains. The benefits are summarized in Table 16.

Table 16

Summary of total average annual flood control benefits for Taylorsville, Bowie, Mize and Harleston Reservoirs (January 1966 prices – project life 1975-2075)

Item	Average annual benefits: Based on 1975 development	To future development	Total
RURAL			
Reduction in damage	$ 370,700	$ 167,900	$ 538,600
Changed land use	553,800	251,200	805,000
Subtotal	924,500	419,100	1,343,600
URBAN			
Reduction in damage	614,600	542,800	1,157,400
TOTAL	$1,539,100	$ 961,900	$2,501,000

The breakdown of flood control benefits by projects is given in Table 17. Since the Taylorsville, Bowie and Mize Reservoirs would function as a flood control system, benefits were distributed to each by the following method. The benefits produced on a flood plain protected only by a particular reservoir were assigned to that reservoir. The benefits from the jointly benefited areas were divided among the projects in proportion to the benefits they would produce in the areas when operated independently.

Table 17

Summary of average annual flood control benefits by projects[1]
(January 1966 prices – project life 1975-2075)

Project	Based on development in 1975						To future development						Total benefits (rounded)		
	Reduction in damages			Change in land use			Reduction in damages			Change in land use					
	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total	Rural	Urban	Total
Taylorsville	113.5	260.5	374.0	296.0	0	296.0	51.2	230.1	281.3	134.3	0	134.3	595	491	1,086
Bowie	149.9	197.5	347.4	152.5	0	152.5	67.9	174.5	242.4	69.2	0	69.2	439	372	811
Mize	82.8	156.6	239.4	105.3	0	105.3	37.5	138.2	175.7	47.7	0	47.7	273	295	568
Harleston	24.5	0	24.5	0	0	0	11.3	0	11.3	0	0	0	36	0	36
Total	370.7	614.6	985.3	553.8	0	553.8	167.9	542.8	710.7	251.2	0	251.2	1,343	1,158	2,501

[1] Values in $1,000

SECTION 4 — FORMULATION AND ANALYSIS OF MAJOR RESERVOIR PROJECTS IN THE EARLY-ACTION PROGRAM

PART A - FORMULATION OF TAYLORSVILLE, BOWIE, MIZE AND HARLESTON RESERVOIRS

INTRODUCTION

As formulated in the Summary Report, the early-action program of structural measures considered to be the most favorable for flood control, water quality control, water supply, recreation, and fish and wildlife enhancement in the Pascagoula River Basin includes development within the next 10 to 15 years of 11 multiple-purpose reservoirs and 17 upstream watershed projects.

Four of the 11 reservoir developments — Taylorsville, Bowie, Mize and Harleston — are major projects for which the Corps of Engineers is to seek Congressional authorization. Formulation and analysis of these projects is summarized in this section.

The other 7 reservoir developments are to be implemented as State of Mississippi projects with Federal aid and are discussed in Part A of Appendix N, prepared by the Pat Harrison Waterway District. The project formulation and evaluation criteria for the upstream watershed projects are presented in Appendix F, prepared by the Department of Agriculture.

DETAILED STUDIES

The final or detailed stage of the studies for the Taylorsville, Bowie, Mize and Harleston reservoir projects involved hydrologic, hydraulic, and structural design studies; economic analyses; and cost studies. The investigations included subsurface explorations to indicate foundation conditions at the four damsites, topographic surveys to establish adequate reservoir mapping data, and topographic surveys to obtain channel and valley cross sections for hydraulic studies.

The sites selected for detailed study were investigated in a wide range of plans formulated for purposes of flood control, water quality control, water supply, recreation, and fish and wildlife enhancement.

Studies made to determine the best plan of development included economic and cost analyses of the reservoirs to arrive at the most favorable amounts of controlled storage for the various purposes. Project formulation and economic analysis required investigation of alternative plans for each included purpose.

In addition to the above projects, studies contained in Appendix H revealed that recreation facilities other than those originally planned would have to be provided at the authorized Okatibbee Reservoir and at the Tallahala Reservoir, now pending authorization, to meet the required scale of development of the recreation resources throughout the basin. The necessary additional facilities at the Okatibbee Reservoir would have a total cost of $850,000 and an annual cost of $45,000. The additional recreation benefits of $442,000 which would be obtained would exceed the annual cost and therefore the facilities would be economically justified. Provision of the facilities is being given consideration in the Master Plan presently being prepared for Okatibbee Reservoir by the Corps of Engineers under existing authority. The additional facilities required at the Tallahala Reservoir for the initial project would have a total cost of $742,000, an annual cost of $39,000, and would provide an additional annual benefit of $594,000. Since development of these additional facilities would be economically justified, consideration will be given to providing them during advanced planning studies, should the project be authorized.

CRITERIA FOR EVALUATION OF COSTS AND BENEFITS

An economic base study was made to evaluate historical growth and to estimate future growth in the Pascagoula River Basin. The projected future growth was useful in measuring the probable increase in water resource requirements, development within the flood plains increasing the need for flood protection, and the potential recreation demand within the influence areas of projects within the basin. The economic base study is presented in Appendix E. Economic studies were made to determine the costs, benefits and economic justification of all projects. The project costs and benefits were evaluated on the basis of January 1966 prices, 100-year project life and an interest rate of 3.25 percent.

Costs. Project costs for the Taylorsville, Bowie, Mize and Harleston developments are based upon estimates of quantities, using the latest surveys and the foundation information available, and upon unit prices current for similar work in the area in 1966. Since facilities for water supply would be provided by local interests and would not be an integral part of the project structures, their cost is not included. Allowances have been made for contingencies, engineering and design, and supervision and administration. Annual charges for the projects include interest and amortization of the total investments at an interest rate of 3.25 percent for a 100-year period, operation and maintenance costs, and annual equivalent cost of major replacements.

Benefits. The average annual benefits due to flood control are twofold, being comprised of reductions in flood losses and change in land use. Reduced flood loss benefits were derived by obtaining the difference in damage that would occur below a given project with and without that project. Change in land use benefits are realized through changing of flood plain cropping practices to include more productive crops and through converting wooded bottomland to cleared land. No urban benefits are attributed to enhancement of the flood plain lands. Pertinent data concerning the flood plains below the investigated projects and the derivation of flood control benefits are presented in Section 3 of this appendix.

Benefits for water quality control and water supply were computed on the basis of the cost of obtaining the same quantity and quality of water by the cheapest alternative means that could be developed by the potential water users in the absence of the Federal project. The alternative means were determined by the Federal Water Pollution Control Administration in close cooperation with the Corps of Engineers and are discussed in Appendix G.

Outdoor recreation benefits were evaluated in the two categories of general recreation and fish and wildlife enhancement. Total activity occasions for general recreation were developed for the initial development stage (1980) and the ultimate development stage (2015) of each project. A factor of 2.3 was used to convert activity occasions to recreation days, assuming that an average recreation day involves 2.3 activities. A weighted value of $0.95 per recreation day was then applied to determine the benefits accruing from general outdoor recreation for each stage of development. A detailed analysis of the benefit determination is given in the report prepared by the Bureau of Outdoor Recreation, included in Appendix H. There was full coordination of this work between the Bureau and the Corps of Engineers and other interested agencies.

Recreation benefits for fish and wildlife enhancement were determined by the Bureau of Sport Fisheries and Wildlife in cooperation with the Mississippi Game and Fish Commission and the Alabama Department of Conservation. Benefits were estimated by determining the amount of man-day use each project would have and applying an estimated value per man-day. Details are given in the Bureau's report, included in Appendix I.

PROJECT FORMULATION

General. Taking into account the urgent and varied needs, the costs of alternatives to solve the needs and the advantages of joint use, it was concluded that multiple-purpose reservoirs at the

Taylorsville, Bowie, Mize and Harleston sites would achieve the best possible use of the water and related land resources employed.

The economic criteria used to formulate these major reservoir projects are those specified in Senate Document No. 97, 87th Congress, "Policies, Standards, and Procedures in the Formulation, Evaluation, and Review of Plans for Use and Development of Water and Related Land Resources." The optimum scale of development in relation to tangible benefits includes all purposes which satisfy the following:

a. Project benefits exceed project economic costs.

b. Each separable purpose provides benefits at least equal to its costs.

c. The scope of development is such as to provide the maximum net benefits.

d. There is no more economical means, evaluated on a comparable basis, of accomplishing the same purpose or purposes which would be precluded from development if the plan were undertaken. This limitation refers only to those alternative possibilities that would be physically displaced or economically precluded from development if the plan is undertaken.

Consideration of intangible benefits may result in selection of a scale of development differing from the optimum (maximized net tangible benefits). Where such deviation is proposed, the optimum scale provides a baseline for judging the effects of such considerations.

Selection of nucleus for Taylorsville, Bowie and Mize Reservoirs. Benefit-to-cost studies of each site for various purposes indicated that single-purpose flood control projects at the Taylorsville, Bowie and Mize sites would be economically feasible and would provide a large amount of net benefits. Accordingly, a single-purpose flood control project at each of these sites was selected as the nucleus around which the multiple-purpose project was formulated. Since the three reservoirs would function as a flood control system, an analysis was made of each operated independently to determine which one would provide the maximum amount of excess flood control benefits over costs. The analysis was made on the basis of flood control storage requirements for the frequency range of once in 10 years to once in 100 years. These studies indicated that flood control storage capacity in the Taylorsville Reservoir, which would control flood volumes having a frequency of occurrence of once in 50 years, would provide the maximum amount of excess flood control benefits over costs.

Therefore, for purposes of maximizing the system, this reservoir was selected as the initial unit of the system.

After selecting the Taylorsville Reservoir as the initial unit for the flood control system, additional studies were made to determine the effect on maximum net flood control benefits of the combination of various flood storage volumes in either the Bowie or Mize Reservoirs with the maximized flood storage volume in Taylorsville Reservoir. These studies revealed that the net flood control benefits would be increased with the provision of additional flood control storage in either Bowie or Mize Reservoirs. The largest increase would be obtained by providing sufficient additional storage in Bowie Reservoir to control flood volumes having a frequency of occurrence of once in 50 years. Accordingly, Bowie Reservoir was selected as the second unit of the system. Next, various flood storage volumes in Mize Reservoir were combined with the maximized flood storage volumes in Taylorsville and Bowie Reservoirs. This revealed that additional flood control storage in Mize Reservoir would also increase the net flood control benefits for the system. Flood control storage capacities in the three reservoirs which would contain flood volumes having a frequency of occurrence of once in 50 years would provide the maximum amount of excess flood control benefits over costs for the system. Therefore, at the Taylorsville, Bowie and Mize sites, the flood control project which would provide storage for the 50-year flood was selected as the nucleus around which to formulate each multiple-purpose project.

Since the Taylorsville, Bowie and Mize Reservoirs would function as a flood control system, an analysis was made to determine the benefits to be used for formulating the multiple-purpose project at each site. For the maximized system, flood control benefits were distributed to each project as follows: (1) benefits produced on a flood plain protected only by a particular reservoir were assigned to that reservoir; and (2) benefits from the jointly benefited areas were divided among the projects in proportion to the benefits they would produce in the areas when operated independently.

Selection of nucleus for Harleston Reservoir. Studies for the Harleston site revealed that a single-purpose flood control project could not be economically justified. However, the Federal Water Pollution Control Administration has determined that there is a need for water quality control and water supply in the area. Benefits for these purposes were measured as the cost of obtaining the same quantity and quality of water by the least costly alternative that would most likely be developed by the potential water users in the absence of the project. Due to the immediate need for water quality control in the area and the fact that benefits for such a purpose in the Harleston project could be obtained only by furnishing the total required amount of

water for lowflow augmentation, a single-purpose water quality control project of the required magnitude was selected as the nucleus around which to formulate the multiple-purpose project.

Formulation of multiple-purpose projects - Taylorsville, Bowie, Mize and Harleston Reservoirs. After the initial sizing of the Taylorsville, Bowie and Mize Reservoirs for flood control and the Harleston Reservoir for water quality control, the scale of development was increased progressively to provide for the other pertinent purposes of flood control, water supply, general recreation and fish and wildlife enhancement, with the combined objectives of maximizing initial project net benefits and satisfying the existing and projected needs allocated to each project. The purposes were added only to the extent that benefits in excess of the costs of adding that purpose to the Multiple-purpose project would be produced.

For the Harleston project, the incremental costs of allocating storage for control of the 10-, 50-, or 100-year flood would be approximately equal due to the design and operational characteristics of an earth dam with a high-level emergency-type spillway, the most economical structure for the multiple-purpose project. Since floods of the magnitude of the 100-year flood have occurred at the downstream gaging station, sufficient storage was allocated to control the 100-year flood.

To investigate the possibility of crediting the highly desirable intangible benefits in the Hattiesburg area to the flood control system above Hattiesburg, the flood control storage in the Taylorsville, Bowie and Mize projects was increased to control the 100-year flood. This allocation of additional storage to flood control would not increase tangible flood control benefits for the system or any single reservoir. However, the costs would be increased only slightly due again to the design and operational characteristics of an earth dam with a high-level emergency-type spillway, the most economical structure for each of the multiple-purpose projects. The slight increase in cost would result in a decrease of approximately one percent in the net flood control benefits for the system. However, this would be more than offset by highly desirable intangible benefits from reducing threats to life and public health posed by the larger floods, particularly to the inhabitants of the urban area of Hattiesburg. Accordingly, the larger storages were allocated for flood control in the multiple-purpose development.

The multiple-purpose developments maximize net benefits for all purposes except general recreation for which initial facilities would meet the expected demand allocated to each project until 1980. Additional facilities would be required to satisfy the projected needs allocated to each project to the year 2015, except for boating and

water skiing which are limited by pool area. Studies revealed that the benefits for these additional facilities would far exceed the costs and thus the facilities could be added to each project. For the economic evaluations in this study, it was assumed that the future development would take place uniformly during the period 1980-2014.

PART B — BASIS OF DESIGNS AND COST ESTIMATES FOR MAJOR RESERVOIRS

SCOPE

Studies performed for the Taylorsville, Bowie, Mize and Harleston Reservoirs were only of sufficient detail to permit establishing the engineering and economic feasibility of each project by determining the proper scale and scope of development and the degree of economic justification. The designs and cost estimates, therefore, are of survey-scope accuracy.

DESIGN CRITERIA

DAM AND APPURTENANCES

Topography. In order to obtain the necessary topographic information for the Taylorsville, Bowie, Mize, and Harleston damsites, surveys of third-order accuracy were made by the Corps of Engineers at each of the proposed sites. Reservoir mapping, to a scale of 1" = 1,000' and contour intervals of 10 feet, was compiled by photogrammetric methods from aerial photographs flown in 1965 and 1966, except for the Harleston Reservoir where the latest U. S. Geological Survey quadrangle maps were used. The mapping for the three reservoirs other than Harleston was prepared by private engineering firms under contract to the Corps of Engineers.

Dams. The applicable engineer manuals and hydraulic design criteria of the Corps of Engineers, together with standard references, were used as guides in designing the dams and appurtenances. The heights of the dams and the types of the foundations eliminated concrete dams after preliminary consideration. On the basis of available subsurface data, provision of high-level, unpaved spillways was considered the most economical, reliable design for use in this report, with storage substituted for spillway capacity. When additional topographic and geologic information is available, further study will be made to establish the final crest elevations. The sections of the earth dams were established after an analysis of the limited geological

borings at the sites. Protection against wave action was provided by 24" of riprap on 9" of filter material below the standard project flood and 18" of riprap and 6" of filter material above the standard project flood. Structural analyses established the wall thickness of the horseshoe-shaped conduits. An 18-foot width for the top of dams was adopted to accommodate a 12-foot service road with 3-foot shoulders. The service bridges were designed to safely accommodate the heaviest piece of equipment requiring access to the intake structures.

Outlet works. The outlet works for the dams were designed to pass between 70 and 100 percent of the downstream channel capacity with the reservoirs at the level of the minimum flood-control pools. The discharge in each case was set after studying estimates of the local inflow which could occur downstream of the project and the type and degree of land use along the downstream channel. Because of the relatively poor foundation conditions at the sites, it was assumed that there would be appreciable and varying settlement along the length of the outlet conduits after the embankment is in place. To avoid the fluctuating pressures and vibrations common to pressure conduits, it was considered imperative in each case that the control gates be placed at the upstream end of the outlet works and the conduit designed for open-channel flow downstream of the gates. The stilling basins were designed to provide a hydraulic-jump for the maximum possible discharge through the outlet works with the reservoirs at the level of the spillway crests. Auxiliary outlets would be provided at one or more levels to effect the release of oxygen-bearing water from near the surface of the reservoirs through the range of the conservation-storage pool levels.

Spillways. Spillways were designed to safely pass the peak outflow of the probable maximum flood with limited heads on the crests varying from 5.9 feet to 7.5 feet. The head limitation was set to minimize the probable erosion of the unprotected spillways during the passing of flood flows because of the erosive nature of the soils in which the spillways were located. This limitation, along with the necessity of keeping the spillway excavation quantities within economical limits, resulted in all spillway crests being set at elevations somewhat above the levels of the standard project floods.

Freeboard. Freeboard for each dam was based on criteria concerning high earth dams as contained in the Corps of Engineers publication, EC 1110-2-27, "Policies and Procedures Pertaining to Determination of Spillway Capacities and Freeboard Allowances for Dams." For added safety, the minimum freeboard used was 4.5 feet.

Foundation preparation. Foundation preparation was based on the conditions at each site as determined by the geologic investigations. The foundation surface for the earth dams would be stripped as necessary to remove organic and other deleterious material. A de-watering

system is proposed to lower the water table during construction of the outlet works and a clay blanket would be placed upstream of the dams where necessary to increase the path of travel of underseepage.

Subsurface investigations. Based on a field reconnaissance at each damsite, selected borings to encounter representative foundation materials were made along the flood plain, abutments, and within the area of the proposed spillway. Four exploratory holes were drilled at the Harleston and Taylorsville sites and three holes were drilled at the Bowie and Oakohay sites. The depths of the borings ranged between 34.5 and 100.5 feet. Continuous split-spoon samples were taken, utilizing the standard penetration test procedure. The samples were visually classified and moisture contents were determined for selected samples.

Construction materials. The commercial sources of natural gravels and sands satisfactory for use as coarse and fine aggregates for concrete work are located at Hattiesburg and Columbus, Mississippi, and Mobile, Alabama. The maximum size coarse aggregate that can be obtained from these sources is $1\frac{1}{2}$ inch. Stone larger than $1\frac{1}{2}$-inch-diameter, including riprap material, could be obtained from quarries in the Birmingham, Alabama, area.

RESERVOIRS

Map coverage. Due to the scale, age, and in some instances, non-existence of standard topographic quadrangle sheets, reservoir mapping by photogrammetric means was employed for all but the Harleston Reservoir. Aerial surveys made in 1965 and 1966 were the basis for the maps which were compiled by private engineering firms. U. S. Geological Survey quadrangle maps to a scale of 1:62,500, contour interval of 10 feet, were used for the Harleston site, since they were considered adequate for survey scope. Table 18 gives a list of maps covering the reservoir sites.

Table 18

Reservoir map coverage for early-action major reservoir projects

Project	Map	Compiled by	Scale
Taylorsville	6 sheets	Smith & Sanders, Inc.	1:12,000
Bowie	5 sheets	Smith & Sanders, Inc.	1:12,000
Mize	4 sheets	Smith & Sanders, Inc.	1:12,000
Harleston	Hurley, Ala-Miss	U. S. Geological Survey	1:62,500
	Wilmer, Ala-Miss	U. S. Geological Survey	1:62,500
	Deer Park, Ala-Miss	U. S. Geological Survey	1:62,500

Storages. Reservoir area-elevation and capacity-elevation relationships were prepared by planimetering successive map contours. Dams were sized on the basis of the storage capacity curves to provide for the required water-use or flood control storages and sediment accumulation over a 100-year period. Each of the four reservoirs would allow for storage of flood water in excess of the 100-year volume allocated to flood control, in lieu of spillway capacity.

Reservoir clearing. Reservoir clearing was estimated on the basis of the distribution of types of land cover as determined from real estate acquisition studies. The guidelines for determining the total amount of land for clearing purposes was established as the conservation pool elevation plus a 2-foot freeboard. A portion of this land would require complete clearing and the remainder would require only modified clearing; consequently, this condition was reflected in the unit cost applied to the total acreage.

Relocations. Estimates of the cost of relocating existing railroad and highway facilities and utilities were based on relocation plans that would provide essentially the same service to remaining areas as would exist before reservoir construction. Cemeteries within the flood pool would be relocated to an area above the guide taking line for the reservoir. Profiles of existing railroads and plans of railroad and highway bridges were used in determining the extent of relocation that would be required for each. The costs of relocating pipelines, telephone and power lines and providing paved access roads to all dams were included in the project estimates. The basis for relocations was established as the elevation of the 50-year-flood pool plus a freeboard of three feet.

Recreation facilities. The facilities necessary to meet the estimated present and future outdoor recreation demand of each project were developed in cooperation with the Bureau of Outdoor Recreation, the Bureau of Sport Fisheries and Wildlife, and the States of Mississippi and Alabama. The basis for attendance and activity days assigned to each project was derived from an economic base study for the Pascagoula River Basin. The cost of providing these facilities was developed by the Corps of Engineers.

Real estate acquisition. The real estate to be purchased for each reservoir project was determined in accordance with the guidelines established by the Army-Interior Joint Policy of 22 February 1962. This policy, taking account of changes through 10 October 1966, requires the fee purchase of minimum land areas in these projects as follows:

1. Lands necessary for the damsite, construction areas, and permanent structures.

2. The lands below a guide taking-line established with a reasonable freeboard allowance above the top pool elevation for storing water for flood control and other purposes, referred to as the "full pool" elevation. In non-urban areas generally, this will include additional allowances of from one to three feet to provide for adverse effects of saturation, wave action, bank erosion, estimated frequency of occurrence, probable accuracy of estimates and similar factors. Where this freeboard does not provide a minimum of 300 feet horizontally from the full pool elevation for storing water, it will be increased to that extent. When the project design provides a high-level spillway, the crest of which for economy of construction is substantially higher than the storage elevation required to regulate the reservoir design flood, the upper level of fee taking will normally be at least equal to the crest elevation of ungated spillways. (This is the case for all four major reservoirs. To meet the detailed requirements listed above, the total fee lands estimated for acquisition are those to spillway crest elevation plus an additional 15 percent to allow for blockout.)

3. Lands required for adequate public access.

4. Flowage easement in lieu of fee title land may be taken for lands that meet all the following conditions: (a) lands lying above the storage pool; (b) lands in remote portions of the project area; (c) lands determined to be of no substantial value for protection or enhancement of fish and wildlife resources, or for public outdoor recreation; (d) it is to the financial advantage of the Government to take easements in lieu of fee title.

Flowage easement rights would be obtained for approximately 3,000 acres of land lying in the upper end of two arms of Taylorsville Reservoir. This land lies upstream from the end of the 100-year flood pool and is not needed for project purposes. Easements were agreed upon as the best use because the land is in the area of influence of one of the 17 upstream watershed projects in the early-action program.

The basic information necessary to develop a real estate cost estimate was assembled by field and office research on a scope consistent with a planning stage estimate. This information included the determination of project land areas to be acquired, the classification of these land areas to similar use groups, the estimation of per acre land value for each use group, and the value of improvements on the project lands. The estimated per acre land values were based on recent comparable sales in or adjacent to each reservoir project. The value and inventory of buildings and other improvements were based on field investigations and reservoir maps.

The estimate of the total real estate acquisition cost was developed for each project by evaluating the land and improvements separately and including costs for resettlement, severance damages, and cemetery relocations where applicable. Contingencies were added in the amount of 15 percent.

PART C — DESCRIPTIONS OF MAJOR RESERVOIR PROJECTS IN THE EARLY-ACTION PROGRAM

SUMMARY

This part presents more detailed descriptions of the Taylorsville, Bowie, Mize, and Harleston Reservoir projects, whose locations are shown on Plate 1 of the Summary Report.

A reservoir map is presented with the description of each project plan. Table 19 contains a summary of the physical data for each project and Table 20 summarizes the economic data.

All costs and benefits shown for the projects were based on the price level of 1966. The costs include allowances for beautification of project lands and facilities and for adequate control of vector problems. The interest rate used for economic analysis was 3.25 percent.

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PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY. VOLUME III. APPENDI--ETC(U)
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Table 19

Summary of pertinent data for proposed Corps of Engineers early-action projects

Item	Taylorsville	Bowie	Mize	Harleston
Site number:	17	21	22	1
Stream	Leaf R.	Bowie Cr.	Oakohay Cr.	Escatawpa R.
Stream mile	131.5	11	28	42
Drainage area, sq. mi.	422	293	150	583
Dam location, county	Smith	Covington	Smith	George-Jackson
Purpose[1]	FC,R,FW,C	FC,WS,R,FW	FC,R,FW,C	FC,WQC,WS,R,FW
Pool elevations, m.s.l.				
Sedimentation	268.0	210.0	298.5	54.5
Conservation (normal)	278.0	236.0	316.0	85.5
Average summer	278.0	236.0	316.0	81.5
Seasonal	---	---	---	---
50-year flood[2]	300.4	252.1	328.5	100.2
100-year flood[2]	301.3	253.0	329.0	101.5
Standard project flood	309.2	260.1	334.8	106.1
Spillway design flood	326.5	274.7	345.9	120.1
Storage volumes, acre-feet				
Sedimentation	9,100	5,600	3,000	16,700
Conservation	28,900	74,400	37,000	258,800
Water supply	---	(74,400)	---	(30,300)
Water quality	---	---	---	(228,500)
Flood control (100-year pool)	195,000	135,700	70,000	323,300
Total, to spillway crest	582,000	428,000	211,000	965,000
Dam dimensions and data				
Type	earthfill	earthfill	earthfill	earthfill
Length, feet	7,500	8,600	5,200	13,700
Maximum height, feet	86.0	94.5	64.5	80.0
Top width, feet	18.0	18.0	18.0	18.0
Top elevation, m.s.l.	331.0	279.5	350.5	125.0
Spillway type	fixed-crest	fixed-crest	fixed-crest	fixed-crest
Spillway length, feet	300	500	1,000	1,300
Spillway crest elev., m.s.l.	319.0	267.5	340.0	114.0
Spillway design flood outflow,c.f.s.	26,000	30,600	42,500	52,400
Conduit U/S invert elev.,m.s.l.	245.0	185.0	286.0	45.0
Conduit D/S invert elev.,m.s.l.	235.0	176.0	278.0	35.0
Conduit discharge, c.f.s.	2,000	1,800	900	3,000
Conduit diameter, feet	11.0	9.0	9.5	11.0
Areas, acres				
Sedimentation pool	1,500	700	800	2,300
Conservation pool	3,500	5,500	3,600	15,900
Average summer pool	3,500	5,500	3,600	14,000
Flood control storage pool	13,700	10,800	7,250	24,100
Spillway crest	26,500	19,000	11,300	32,700
Total to be acquired	31,000[3]	22,450	13,600	38,100

[1] FC = Flood control, WQC = Water quality control, WS = Water supply, R = General recreation, FW = Fish & wildlife, C = Conservation for future water use needs.
[2] 48-hour rainfall
[3] Includes 3,000 acres on which flowage easement rights will be obtained.

Table 20

Summary of economic data for proposed Corps of Engineers early-action projects
(Values in $1,000)

Item	Taylorsville	Bowie	Mize	Harleston	Total
FIRST COST AND INVESTMENT					
Lands and damages	4,517	2,489	1,937	6,241	15,184
Relocations	3,445	2,944	896	11,443	18,728
Reservoir and pool preparation	822	1,162	776	3,051	5,811
Dams	8,591	8,552	5,711	14,612	37,466
Access roads	106	138	78	152	474
Public use and access	1,323	1,928	1,323	4,792	9,366
Buildings, grounds and utilities	160	160	160	184	664
Permanent operating equipment	75	75	76	138	364
Engineering and design	1,627	1,665	1,040	3,359	7,691
Supervision and administration	1,234	1,287	803	2,528	5,852
Initial project first cost	21,900	20,400	12,800	46,500	101,600
Interest during construction	1,424	1,326	832	3,778	7,360
Gross & initial project investment	23,324	21,726	13,632	50,278	108,960
Delayed investment	2,692	4,174	2,722	10,459	20,047
Delayed investment (present worth)	(1,050)	(1,631)	(1,064)	(4,100)	(7,847)
Total project first cost	24,592	24,574	15,522	56,959	121,647
Total project gross & net investment	26,016	25,900	16,354	60,737	129,007
ANNUAL CHARGES					
Initial project:					
Interest	758	706	443	1,634	3,541
Amortization	32	30	19	69	150
Operation & maintenance (with major replacements)	140	121	86	214	561
Total initial project	930	857	548	1,917	4,252
Delayed project:					
Interest	34	53	35	133	255
Amortization	1	2	1	6	10
Operation & maintenance	22	35	26	150	233
Total delayed project	57	90	62	289	498
Total project:					
Interest	792	759	478	1,767	3,796
Amortization	33	32	20	75	160
Operation & maintenance (with major replacements)	162	156	112	364	794
Total project annual charges	987	947	610	2,206	4,750
ANNUAL BENEFITS					
Initial project:					
Flood control	1,086	811	568	36	2,501
Water quality control	---	---	---	940	940
Water supply	---	109	---	460	569
Recreation	736	1,156	756	2,942	5,590
(General recreation)	(690)	(1,084)	(709)	(2,759)	(5,242)
(Fish and wildlife)	(46)	(72)	(47)	(183)	(348)
Total initial project	1,822	2,076	1,324	4,378	9,600
Delayed project:					
Recreation	642	1,009	661	2,570	4,882
Total delayed project	642	1,009	661	2,570	4,882
Total project annual benefits	2,464	3,085	1,985	6,948	14,482
BENEFIT-TO-COST RATIO					
Initial project	2.0	2.4	2.4	2.3	2.3
Total project	2.5	3.3	3.3	3.1	3.0

TAYLORSVILLE RESERVOIR

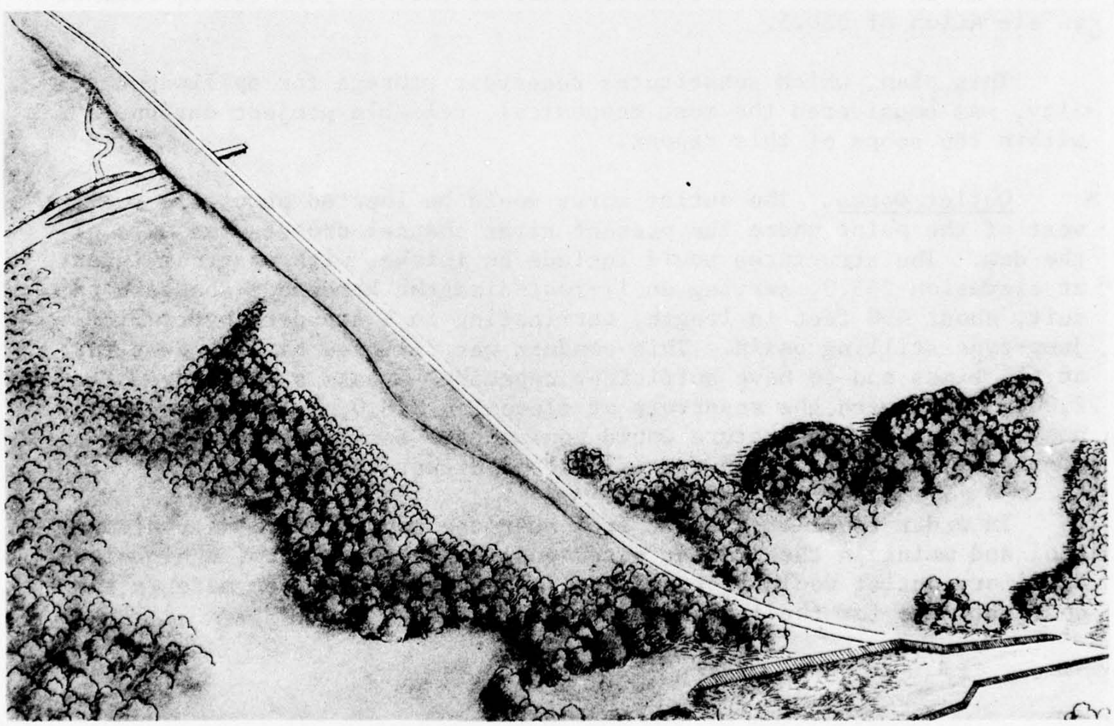
GENERAL

The Leaf River from its source in Scott County, Mississippi, flows generally southward to Hattiesburg, then southeastward to Merrill, where it joins the Chickasawhay River to form the Pascagoula River. The Leaf River Basin, with a drainage area of 3,580 square miles, has an overall length of about 110 miles. The Taylorsville dam would be located in the upper third of the basin in southeastern Smith County at approximate mile 131.5, about 60 river miles above Hattiesburg. The drainage area above the site is 422 square miles, representing 24 percent of that of the Leaf River above Hattiesburg. At full conservation pool, elevation 278.0 m.s.l., the lake would extend about 9 miles upstream from the dam and would have a maximum width of about 1.5 miles.

The plan for the Taylorsville project includes an earth dam, a high-level, fixed-crest emergency spillway, an intake structure and an outlet conduit with a stilling basin. An artist's conception of the project is shown in Figure 15.

Figure 15

Artist's conception of Taylorsville Dam



PROJECT PLAN

Dam. The earth dam would be 7,500 feet long and have a maximum height of 86 feet. The top of dam would be at elevation 331.0 and would provide a 4.5-foot freeboard above the spillway design flood pool and a 29.7-foot freeboard above full flood control pool. The top width of the dam would be 18.0 feet, providing ample room for a 12-foot-wide service road. The slope of the upstream face of the dam would be 1 vertical on 4 horizontal from the base to elevation 309.2, and 1 vertical on 2.5 horizontal from elevation 309.2 to the top and would be covered by riprap. The downstream slope of the dam would be 1 vertical on 3 horizontal and would not require riprapping. Instead, the downstream slope and the portion of the top of dam not covered by the service road would be grassed.

Spillway. The emergency spillway would be located in a saddle about 1,000 feet east of the left abutment of the dam and would consist of an unpaved, free-overflow section having a 300-foot-long crest at elevation 319.0, which would be 9.8 feet above the standard project flood pool elevation. The length and crest elevation of the spillway selected would fit the topography without requiring an excessive amount of excavation. Normal operation of the reservoir would limit the use of the spillway to floods larger than 66 percent of the spillway design flood series. The spillway design flood, when routed through the reservoir on an initial pool equal to that of the 100-year flood, reached an elevation of 326.5.

This plan, which substitutes reservoir storage for spillway capacity, was considered the most economical, reliable project design within the scope of this report.

Outlet works. The outlet works would be located about 450 feet west of the point where the present river channel crosses the axis of the dam. The structures would include an intake, with upstream invert at elevation 245.0, serving an 11-foot-diameter horseshoe-shaped conduit, about 450 feet in length, terminating in a standard hydraulic-jump-type stilling basin. This conduit was designed to flow part full at all times and to have sufficient capacity to pass a discharge of 2,000 c.f.s. with the reservoir at elevation 278.0, full conservation pool. The intake structure would contain two service gates and two emergency gates, each 4.5 feet wide by 8.0 feet high.

In order to release water from near the top of the conservation pool and maintain the present water quality in the stream, a high-level auxiliary outlet would be required. Allowances have been made in the cost estimate for the inclusion of this outlet.

Reservoir. The Taylorsville Reservoir would have an area of 3,500 acres at conservation pool elevation 278.0. Flood control storage of 195,000 acre-feet (8.7 inches of runoff) would be available between elevations 278.0 and 301.3. An additional storage of 349,000 acre-feet (15.5 inches of runoff), not assigned for project purposes, would be available between elevation 301.3 and the spillway crest at elevation 319.0 to store floods greater than the 100-year flood. Conservation storage of 38,000 acre-feet below elevation 278.0 includes 9,100 acre-feet for sediment accumulation and 28,900 acre-feet for recreation and possible future water use needs. The reservoir is shown on Figure 16.

Recreation facilities. The initial general recreation facilities for the Taylorsville project were determined, in close cooperation with the Bureau of Outdoor Recreation, as necessary to meet the expected needs of the project area in 1980. Included are 2 overlooks, 3 boat launching areas, 7 camping areas, 12 picnicking areas, 18 acres of swimming beaches, and 9 miles of hiking trails. The delayed facilities, estimated to be constructed over a 35-year period (1980-2014), are those necessary to keep pace with the projected demand. These include 20 camping areas, 18 picnicking areas, and 44 acres of swimming beaches. The Bureau of Outdoor Recreation report, presented as Appendix H, gives data relevant to the inclusion of these facilities as part of the project plan.

The requirements for reservoir and tailrace access for fish and wildlife purposes were derived in cooperation with the Bureau of Sport Fisheries and Wildlife and were based on the report of that agency contained in Appendix I. Planned fish and wildlife facilities include 2 reservoir access areas and 2 tailrace access areas.

The locations of the general recreation and fish and wildlife facilities were not set for this report but would be determined by the Corps of Engineers during the advanced planning stage following authorization of the project by the Congress.

Real estate requirements. The guideline for acquisition of real estate for reservoir regulation was taken as the blockout, by percentage factor, of the 319-foot contour (spillway crest elevation). The area thus defined would total 30,500 acres, of which 9,500 acres are cleared and 21,000 acres are wooded. Flowage easement rights would be obtained on 3,000 acres, leaving a balance of 27,500 acres to be purchased in fee. An additional 500 acres of land would be required for specific recreational purposes. The mineral estate underlying the reservoir would be subordinated.

Relocations. Relocations within the proposed reservoir area would consist of approximately 7.0 miles of State and county roads,

12.5 miles of privately-owned gas lines and 2.0 miles of transmission lines. In addition, the re-interment of approximately 600 graves would be required.

Foundation conditions. The damsite lies within the Long Leaf Pine Hills physiographic division of the Gulf Coastal Plain. The region is maturely dissected with rolling hills and moderately rugged divides between streams. At the site, the Leaf River flood plain is heavily wooded and somewhat marshy, lying about 75 to 100 feet below the surrounding hills. The site is underlain by varicolored clays and sand of the Catahoula Formation of Miocene Age. The soils from the spillway section are suitable for use as fill material in the dam. No underseepage problems are anticipated and geologic conditions at the site are considered favorable for construction of an earth dam.

COSTS

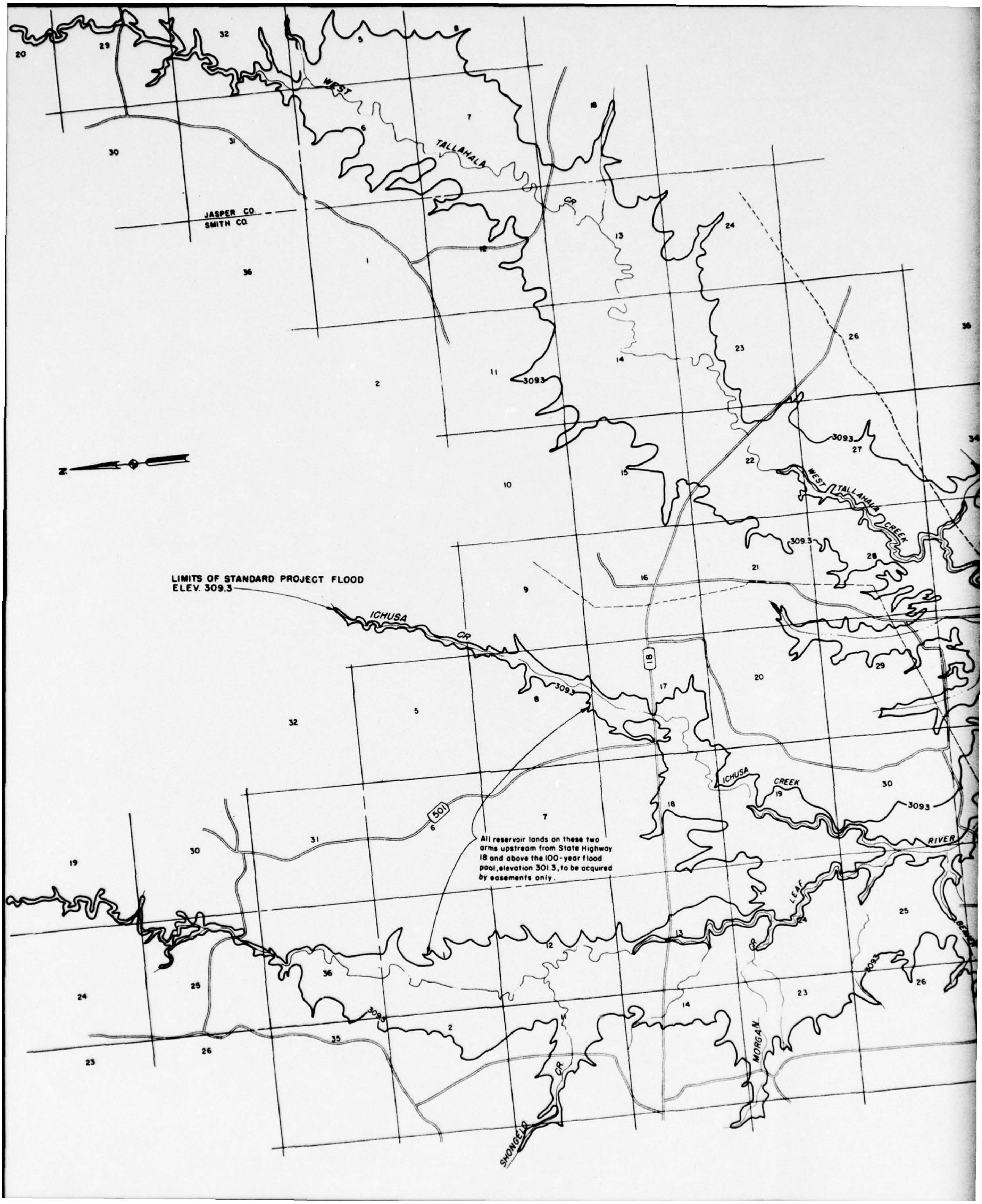
The total initial first cost of the Taylorsville project is estimated to be $21,900,000 and the total with delayed recreational facilities is $24,592,000. A summary of first costs of the principal features of the project is given in Table 20.

In determining the gross and net investment for the initial project, interest during construction was estimated over a 4-year period of construction, assuming equal annual expenditures of the first cost. The present worth for the value of salvageable lands at the end of the 100-year project life was ignored, thereby making the gross and net investment the same for the initial project. In determining the present worth of gross and net investment for the total project, the construction of the delayed recreation facilities was assumed to take place over a period of 35 years (1980-2014) with equal annual expenditures during this period. Interest during construction for the delayed works was not considered in the evaluation. Table 20 presents a summary of the first cost and investment for the Taylorsville project.

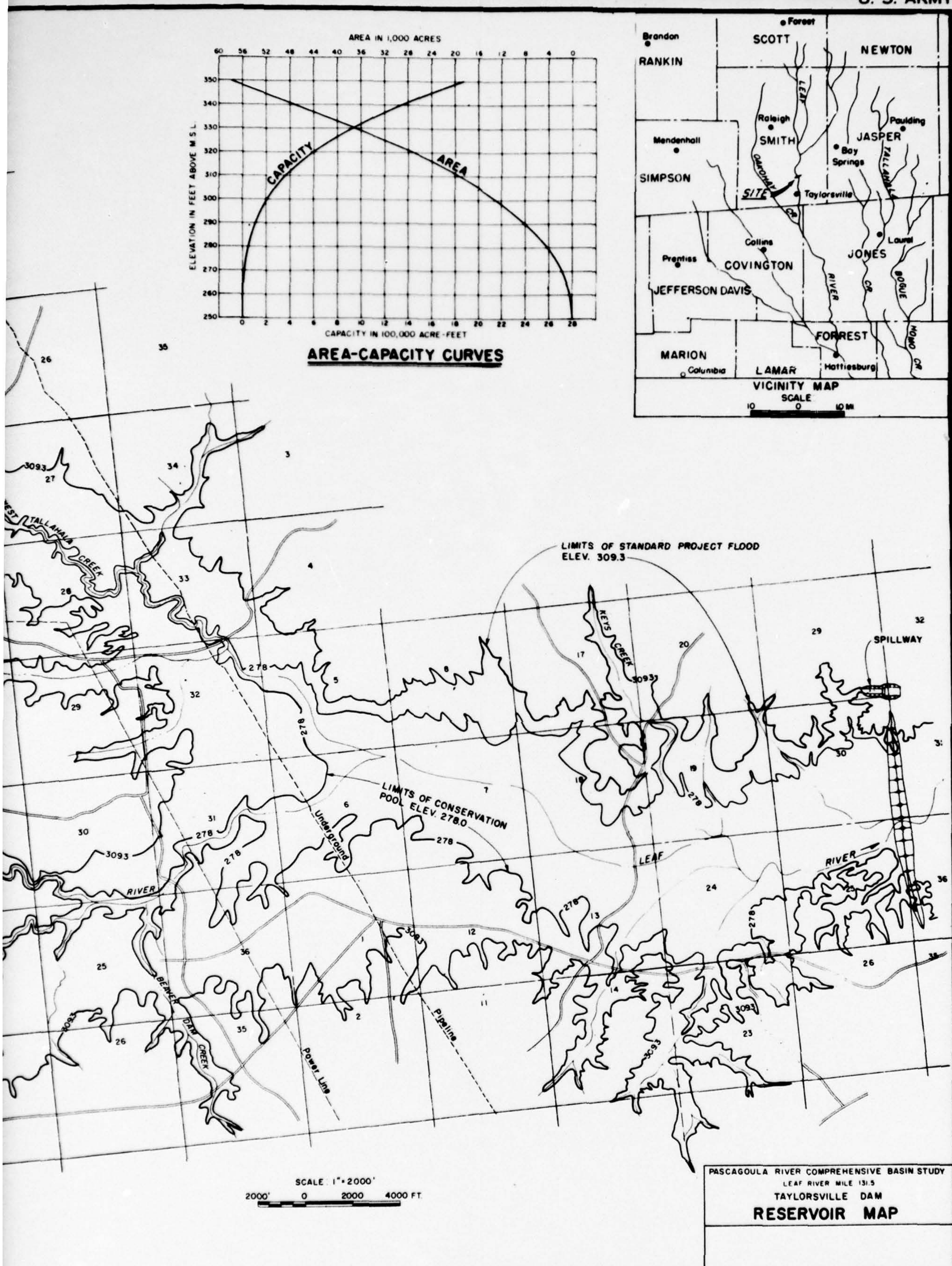
Total annual charges for the development are estimated to be $987,000 based on a project life of 100 years (1975-2075) and using an interest rate of 3.25 percent. A summary of the annual charges is presented in Table 20.

BENEFITS

General. The Taylorsville project would be constructed for flood control and recreation purposes, consisting of general recreation and fish and wildlife enhancement. The tangible, intangible and area redevelopment benefits accruing to the project are discussed in the following paragraphs. However, area redevelopment benefits and



LIMITS OF STANDARD PROJECT FLOOD
ELEV. 309.3
All reservoir lands on these two arms upstream from State Highway 18 and above the 100-year flood pool, elevation 301.3, to be acquired by easements only.
JASPER CO.
SMITH CO.
WEST TALLAHALA CR
WEST TALLAHALA CREEK
ICHUSA CR
ICHUSA CREEK
LEAF RIVER
MORGAN CR
SHONGELO CR
309.3
18
501
N



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY
LEAF RIVER MILE 131.5
TAYLORSVILLE DAM
RESERVOIR MAP

FIGURE 16

intangible benefits were not considered in determining project justification.

Flood control. Flood control benefits attributable to the Taylorsville project would result from the control of the runoff from the 422-square-mile drainage area above the site. The dam is one of a system of three proposed for effectively controlling floods at Hattiesburg and other urban areas. This city and the communities of Petal, Harvey, New Augusta, Beaumont and McLain contain 1,320 acres of urban land subject to inundation that would be affected by the Taylorsville project. In addition to these urban areas, approximately 83,600 acres of rural land downstream of the proposed site would receive a varying degree of flood protection. Flood control benefits credited to the operation of this project are comprised of reduced flood losses and change in land use, both to present and future development. "Present" development was considered to be for 1975, the assumed year that benefits could begin accruing to the project.

The average annual benefit to present development would be $670,000, of which $409,500 would be rural and $260,500 urban. The estimated benefits to future development are $416,000, of which $186,000 are to the rural area and $230,000 to the urban area. The total average annual flood control benefits to present and future development would, therefore, be $1,086,000. No urban benefits were attributed to enhancement of the flood plain lands. The derivations of the flood control benefits is presented in Section 3 of this appendix.

Recreation. Benefits accruing to the Taylorsville project for inclusion of recreation as a purpose were determined by agencies of the Department of the Interior, with close cooperation by the Corps of Engineers. General recreation benefits as determined by the Bureau of Outdoor Recreation are presented in Appendix H, and the benefits attributable to fish and wildlife enhancement as determined by the Bureau of Sport Fisheries and Wildlife are contained in Appendix I.

The annual visitor-day attendance expected at this project for general recreation activities by 1980 is 732,850, increasing to 2,083,950 by the year 2015 when the ultimate development stage is reached. Using a weighted value of $0.95 per recreation day, the benefits for the initial development stage were determined to be $696,000 in 1980. By 2015, with the installation of the delayed facilities, this would increase to $1,980,000. These benefits discounted to 1975, the assumed completion date of the initial project, would have an average annual value of $1,332,000, of which $690,000 would be due to the initial project and $642,000 due to the delayed works.

The estimated man-day attendance for reservoir and tailrace fishing is 19,250 in 1980 and 70,000 in 2015. An average of 350 man-days of waterfowl hunting is estimated throughout the life of the project. There would be approximately 2,625 man-days of hunting lost initially because of the inundation of the bottomlands within the reservoir area. These losses would be mitigated by making available for wildlife management those areas not needed for other project purposes. This would assure development and management of wildlife resources for maximum public benefit. The average annual benefits to fish and wildlife enhancement due to the development of the total project would be $46,000.

Area redevelopment. Seven counties in Mississippi and an Indian reservation within a 50-mile commuting distance of the proposed Taylorsville project meet (as of October 1967) the criteria for area redevelopment assistance specified in title IV, section 401(a) of the Public Works and Economic Development Act (Public Law 89-136). The counties of Clarke, Jasper, Lawrence and Newton qualify because of excessive unemployment, and the counties of Covington, Jefferson Davis and Smith qualify because of the low median family income. The Choctaw Reservation, in several nearly counties, qualifies by virtue of being an Indian Reservation and being recommended by the Bureau of Indian Affairs.

Area redevelopment benefits attributed to the project would result from the value of wages and salaries paid for labor during the construction period and the wages and salaries paid operating personnel for a 20-year period after completion of the initial project construction. Based on the unemployment in the area, it was assumed that essentially all labor requirements for construction of the project could be filled from within the area by the unemployed labor force or that jobs vacated by direct hires would in turn be filled from the unemployed labor force. The values of these wages and salaries were converted to present value at the time the initial project was assumed to be completed and amortized over the 100-year project life. The average annual benefits accruing to the Taylorsville project from area redevelopment are estimated to be $217,000, of which $185,000 would be for wages and salaries paid during construction and $32,000 for wages and salaries paid operating personnel.

Intangible benefits. Benefits other than those assigned a monetary value would follow construction of the proposed Taylorsville project. The possibility of loss of life from floods would be lessened in the reservoir area and downstream of the project, particularly at Hattiesburg and in the bridge crossing areas which are subject to inundation and washout. The project would improve sanitary conditions, which sometimes become hazardous during prolonged periods of highwater because of infiltration of flood waters into wells and creation of

additional mosquito breeding grounds. The transportation systems serving the area would be relieved of schedule interruptions, thereby eliminating considerable inconvenience in addition to the monetary losses. The scenic improvements in the reservoir area and the availability of fresh-water recreational opportunities would enhance the lands adjacent to the proposed reservoir and immediately downstream from the project and would result in an increase in real estate values.

Benefit summary. The total average annual benefits attributable to the Taylorsville project purposes would be $2,464,000, of which $1,822,000 would accrue to the initial project and $642,000 to the delayed works. A summary of these benefits is given in Table 20. Area redevelopment benefits, equivalent to $217,000 per year over the life of the project, would increase the total average annual benefits to $2,681,000.

COMPARISON OF BENEFITS AND COSTS

The total annual benefits of $2,464,000 for the Taylorsville project, excluding economic redevelopment benefits would exceed the average annual cost of $987,000, giving a benefit-to-cost ratio of 2.5. Including $217,000 annually for the economic redevelopment benefits would increase the ratio to 2.7.

BOWIE RESERVOIR

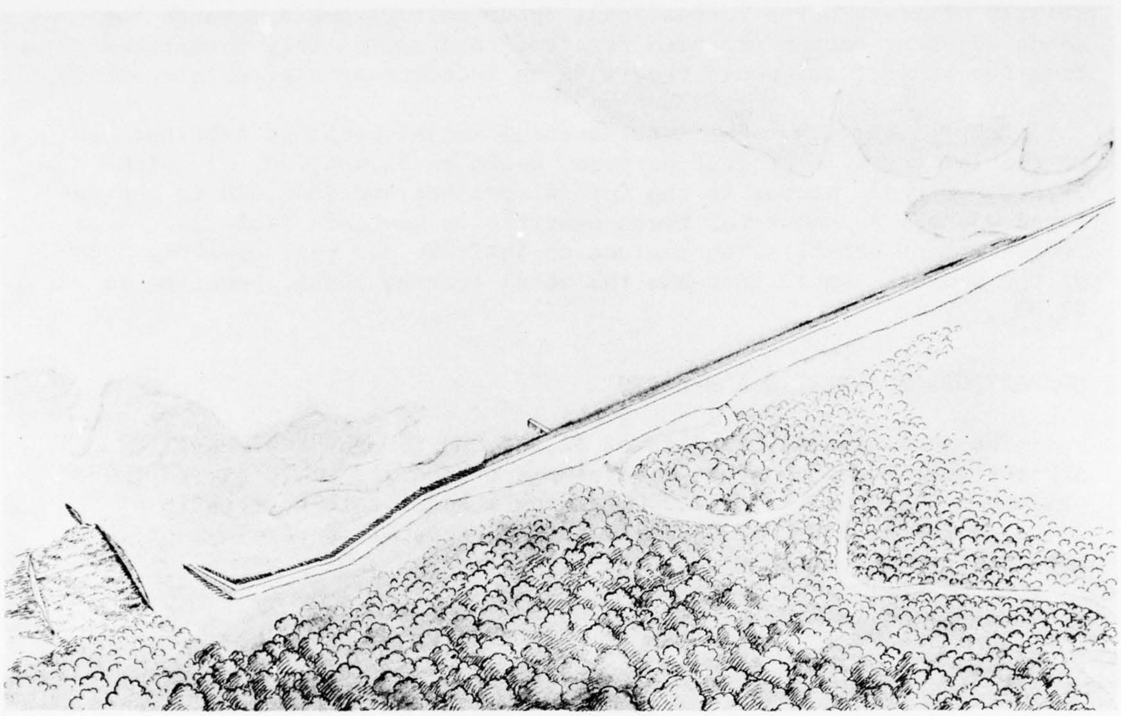
GENERAL

The Bowie Creek rises in Simpson County, Mississippi, and flows generally southeastward to join with Okatoma Creek and form the Bowie River. This river continues southeastwardly for about 14 miles to its juncture with the Leaf River at Hattiesburg. The Bowie Creek basin has a maximum length of approximately 38 miles and a maximum width of about 12 miles. The dam would be located in the southwestern corner of Covington County at approximate mile 11 on Bowie Creek, about 15 miles northwest of Hattiesburg. The drainage area at the site is 293 square miles, or about 45 percent of the Bowie River basin above Hattiesburg. At full conservation pool, elevation 236.0 m.s.l., the lake would extend about 7.5 miles upstream from the dam and would have a maximum width of about 1.5 miles.

The plan for the Bowie project includes an earth dam, a high-level, fixed-crest emergency spillway, an intake structure and an outlet conduit with a stilling basin. Figure 17 shows an artist's conception of the project.

Figure 17

Artist's conception of Bowie Dam



PROJECT PLAN

Dam. The earth dam would be 8,600 feet long and have a maximum height of 94.5 feet. The top of dam at elevation 279.5 would provide a 4.8-foot freeboard above the spillway design flood pool and a 26.5-foot freeboard above full flood control pool. The top width of the dam would be 18.0 feet, providing ample room for a service road. The slope of the upstream face of the dam would be 1 vertical on 4 horizontal from the base to elevation 260.1, 1 vertical on 2.5 horizontal from elevation 260.1 to the top, and would be covered by riprap. The downstream slope of the dam would be 1 vertical on 3 horizontal and would be grassed, along with the portion of the top of dam not covered by the service road.

Spillway. The emergency spillway would be cut through a ridge about 2,000 feet southwest of the right abutment of the dam and would consist of an unpaved free-overflow section having a 500-foot-long

crest at elevation 267.5, which would be 7.4 feet above the standard project flood pool elevation. The length and crest elevation of the spillway selected would fit the topography without requiring an excessive amount of excavation. Normal operation of the reservoir would limit the use of the spillway to floods larger than 61 percent of the spillway design flood series. The spillway design flood, when routed through the reservoir on an initial pool equal to that of the 100-year flood, reached an elevation of 274.7.

This plan, which substitutes reservoir storage for spillway capacity, was considered the most economical, reliable project design within the scope of this report.

Outlet works. The outlet works would be located about 500 feet south of the present creek channel. The structures would include an intake, with upstream invert at elevation 185.0, serving a 9-foot-diameter horseshoe-shaped conduit, about 445 feet in length, terminating in a standard hydraulic-jump-type stilling basin. This conduit was designed to flow part full at all times and to have sufficient capacity to pass a discharge of 1,800 c.f.s. with the reservoir at elevation 236.0, full conservation pool. The intake structure would contain two service gates, 3 feet wide by 7.5 feet high, and two emergency gates of the same size.

In order to release water from near the top of conservation pool to maintain the present stream quality, a high-level auxiliary outlet would be required. Allowances have been made in the cost estimate for the inclusion of this outlet.

Reservoir. The Bowie Reservoir would have 80,000 acre-feet of storage at elevation 236.0, of which 74,400 acre-feet between elevations 210.0 and 236.0 would be for water supply and 5,600 acre-feet below elevation 210.0 would be for sediment accumulation. The reservoir would have an area of 5,500 acres at conservation pool elevation 236.0. Flood control storage of 135,700 acre-feet (8.7 inches of runoff) would be available from elevation 236.0 to elevation 253.0, with an additional storage of 212,300 acre-feet (13.6 inches of runoff), not assigned for project purposes, available to spillway crest. The reservoir is shown on Figure 18.

Recreation facilities. The initial general recreation facilities for the Bowie project were determined, in close cooperation with the Bureau of Outdoor Recreation, as necessary to meet the expected needs of the project area in 1980. Included are 2 overlooks, 4 boat launching areas, 10 camping areas, 19 picnicking areas, 28 acres of swimming beaches, and 6 miles of hiking trails. The delayed facilities, estimated to be constructed over a 35-year period (1980-2014), are those necessary to keep pace with the projected demand. These include 31

camping areas, 28 picnicking areas, and 68 acres of swimming beaches. The Bureau of Outdoor Recreation report, presented as Appendix H, gives data relevant to the inclusion of these facilities as part of the project plan.

The requirements for reservoir and tailrace access for fish and wildlife purposes were derived in cooperation with the Bureau of Sport Fisheries and Wildlife and were based on the report of that agency contained in Appendix I. Planned fish and wildlife facilities include 2 reservoir access areas and 2 tailrace access areas.

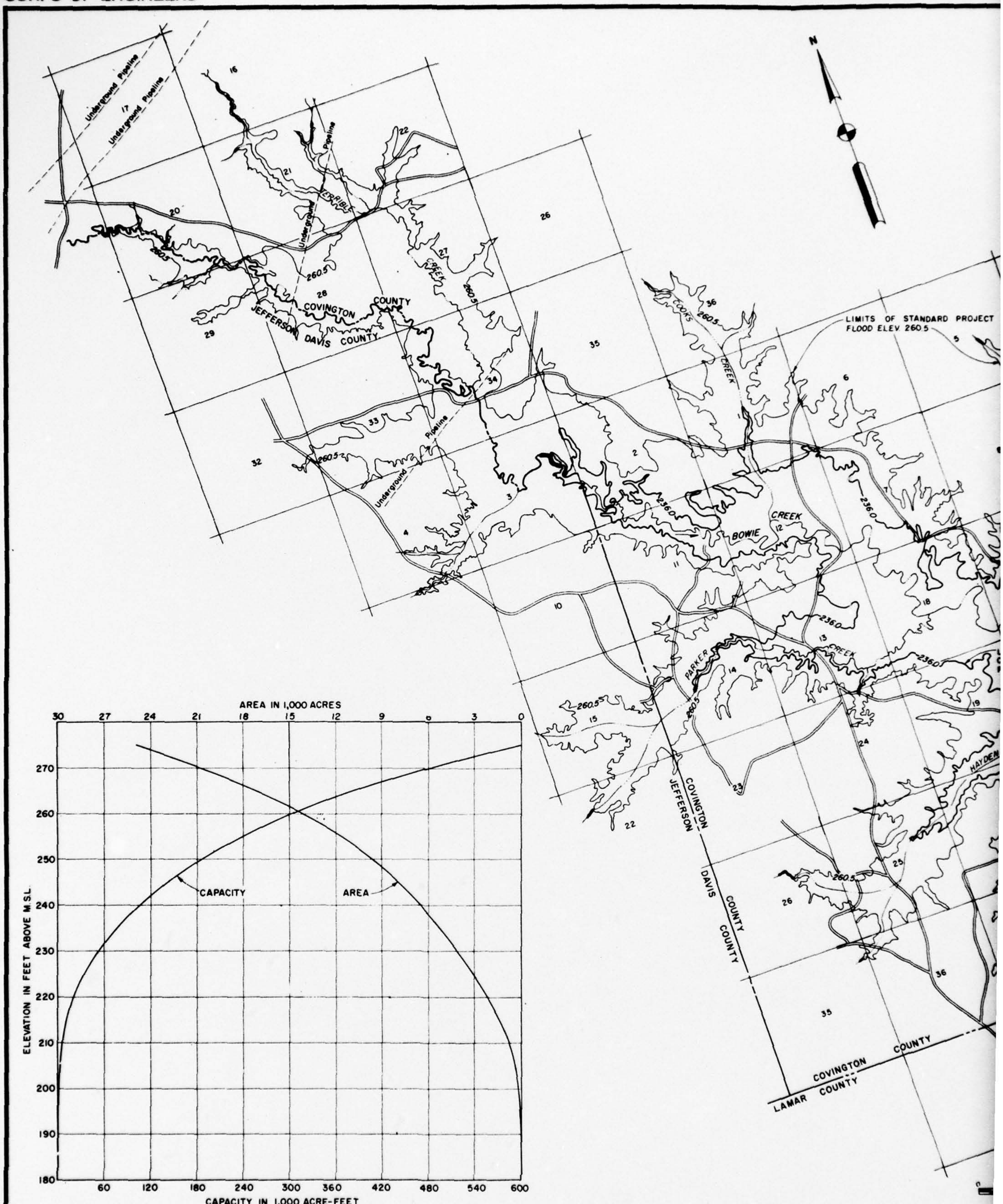
The locations of the general recreation and fish and wildlife facilities were not set for this report and would be determined by the Corps of Engineers during the advanced planning stage following authorization of the project by the Congress.

Water supply structures. Intakes, pumps and conduit for municipal and industrial water would be constructed by local interests apart from the project structures and are not covered in this report.

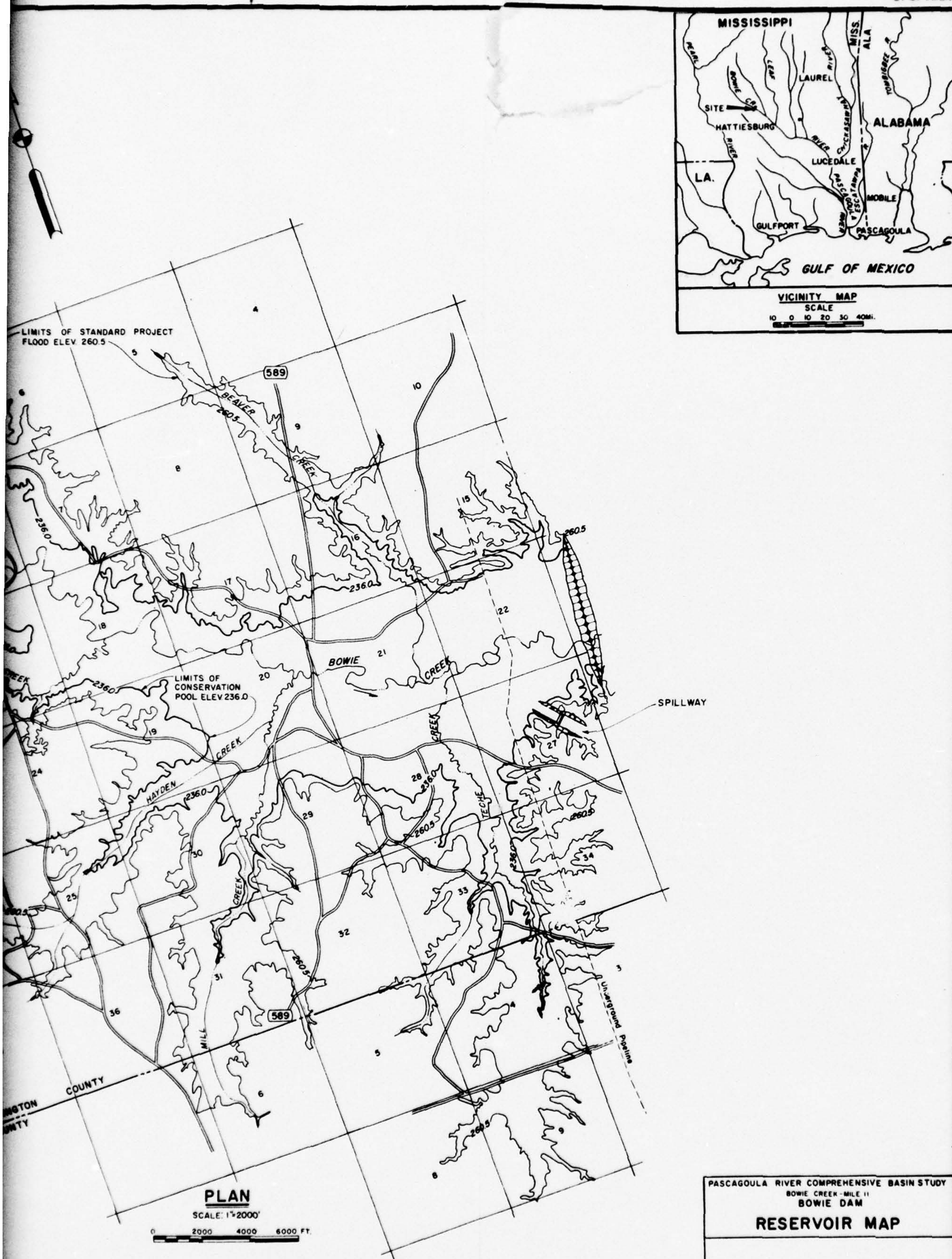
Real estate requirements. The guideline for acquisition of real estate for reservoir regulation was established as the blockout, by percentage factor, of the 267.5-foot contour (spillway crest elevation). The area thus defined would amount to 21,850 acres, of which about 2,200 are cleared and the remainder are wooded. An additional 600 acres of land would be required for specific recreational purposes. The full mineral estate would be acquired.

Relocations. Approximately 7.5 miles of State and county roads, 3,000 feet of bridges, 6.0 miles of utility lines, and 4.5 miles of privately owned gas lines within the reservoir area would have to be relocated. In addition, the re-interment of approximately 350 graves would be required.

Foundation conditions. The damsite is located within the Long Leaf Pine Hills physiographic division of the Gulf Coastal Plain. The surface is maturely dissected and gently rolling with moderately rugged divides separating stream valleys. The flood plain of Bowie Creek along the proposed axis is a flat, marshy area that lies 80 to 100 feet below the elevations of the surrounding hills. The site is underlain by the Pascagoula and Hattiesburg Clay Formations of Miocene Age, which dip in a southerly direction. The flood plain along the axis of the dam is covered by alluvial soils about 22 feet thick. Most of the soils from the spillway section are suitable for use as fill material in the dam. Geologic conditions are favorable for construction of an earth dam at this site.



AREA-CAPACITY CURVES



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY
BOWIE CREEK - MILE 11
BOWIE DAM

RESERVOIR MAP

FIGURE 18

COSTS

The total initial first cost of the Bowie project is estimated to be $20,400,000 and the total with delayed recreational facilities is $24,574,000. A summary of first costs of the principal features of the project is given in Table 20.

In determining the gross and net investment for the initial project, interest during construction was estimated over a 4-year construction period, assuming equal annual expenditures of the first cost. The present worth for the value of salvageable lands at the end of the 100-year project life was ignored, thereby making the gross and net investment the same for the initial project. In determining the present worth of gross and net investment for the total project, the construction of the delayed recreation facilities was assumed to take place over a period of 35 years (1980-2014) with equal annual expenditures during this period. Interest during construction for the delayed works was not considered in the evaluation. Table 20 presents a summary of the first cost and investment for the Bowie project.

Total annual charges for the development are estimated to be $947,000, based on a project life of 100 years (1975-2075) and using an interest rate of 3.25 percent. A summary of the annual charges is presented in Table 20.

BENEFITS

General. The Bowie project would be constructed for the purposes of flood control, water supply and recreation. Recreation consists of general recreation and fish and wildlife enhancement. The tangible, intangible and area redevelopment benefits accruing to the project are discussed below. However, area redevelopment benefits and intangible benefits were not considered in determining project justification.

Flood control. Benefits attributable to flood control for the Bowie project would result from the control of the runoff from the 293 square mile drainage area above the site. The dam is one of a system of three proposed for effectively controlling floods at Hattiesburg and other urban areas. This city and the communities of Petal, Harvey, New Augusta, Beaumont and McLain, contain 1,620 acres of urban land subject to inundation that would be affected by the Bowie project. In addition to these urban areas, approximately 66,100 acres of rural flood plain land downstream from the site would receive a varying degree of flood protection. Flood control benefits credited to the operation of this project are comprised of reduced flood losses and change in land use to both present and future development. "Present" development was considered to be for 1975, the assumed year that benefits could begin accruing to the project.

The average annual benefit to present development would be $500,000, of which $302,000 would be rural and $198,000 urban. The estimated annual benefits to future development are $311,000, of which $137,000 are to the rural area and $174,000 to the urban area. The total average annual benefits to present and future development would therefore be $811,000. No benefits were attributed to enhancement of urban land in the flood plain. The derivation of the flood control benefits is presented in Section 3 of this appendix.

Water supply. The value of 74,400 acre-feet of reservoir storage in the Bowie project to provide municipal and industrial water supply for the Hattiesburg area was determined by the Federal Water Pollution Control Administration, and confirmed by the Corps of Engineers. This storage is equivalent to a flow of 108 million gallons per day throughout the life of the reservoir. The least-cost alternative for providing this supply was the annual cost of providing a small single-purpose dam to augment flow of the Leaf River at Hattiesburg, whereby the water could be pumped from the river and treated. The annual cost for this alternative was estimated to be $109,000, which was considered as the average annual benefit for this purpose. The alternatives considered for this evaluation are presented in Appendix G.

Recreation. Benefits accruing to the Bowie project for inclusion of recreation as a purpose were determined by agencies of the Department of the Interior, in close cooperation with the Corps of Engineers. General recreation benefits as determined by the Bureau of Outdoor Recreation are presented in Appendix H, and the benefits attributable to fish and wildlife enhancement as determined by the Bureau of Sport Fisheries and Wildlife are contained in Appendix I.

The annual visitor-day attendance expected at this project for general recreation activities by 1980 is 1,151,600, increasing to 3,274,800 by the year 2015 when the ultimate development stage is reached. Using a weighted value of $0.95 per recreation day, the benefits for the initial development stage were determined to be $1,094,000 in 1980. By 2015, with the installation of the delayed facilities, this would increase to $3,111,000. These benefits, discounted to 1975, the assumed completion date of the initial project, would have an average annual value of $2,093,000, of which $1,084,000 would be due to the initial project and $1,009,000 due to the delayed works.

The estimated annual man-day attendance for fishing, reservoir and tailrace, is 30,250 in 1980 and 110,000 in 2015. An average of 550 man-days of waterfowl hunting is estimated throughout the life of the project. There would be approximately 4,125 man-days of hunting lost initially because of the inundation of the bottomlands within the

reservoir area. These losses would be mitigated by making available for wildlife management those lands not needed for other project purposes. This would assure development and management of wildlife resources for maximum public benefit. The average annual benefits to fish and wildlife enhancement accruing to the project would be $72,000.

<u>Area redevelopment</u>. Six counties in Mississippi, one urban area and an Indian Reservation within a 50-mile commuting distance of the proposed Bowie project meet (as of October 1967) the criteria for area redevelopment assistance specified in title IV, section 401(a) of the Public Works and Economic Development Act (Public Law 89-136). The counties of Clarke, Jasper, Lawrence and Walthall qualify because of excessive unemployment, and the counties of Covington and Smith qualify because of low median family income. The Choctaw Reservation, in several nearby counties, qualifies by virtue of being an Indian Reservation and being recommended by the Bureau of Indian Affairs. Richton, Mississippi (Perry County) meets the criteria for qualification under title I, section 102, of the Act.

Area redevelopment benefits attributed to the project would result from the value of wages and salaries paid for labor during the construction period and the wages and salaries paid operating personnel for a 20-year period after completion of the initial project construction. Based on the unemployment in the area, it was assumed that essentially all labor requirements for construction of the project could be filled from within the area by the unemployed labor force or that jobs vacated by direct hires would in turn be filled from the unemployed labor force. The values of these wages and salaries were converted to present value at the time the initial project was assumed to be completed and amortized over the 100-year project life. The average annual benefits accruing to the Bowie project from area redevelopment are estimated to be $216,000, of which $189,000 would be for wages and salaries paid during construction and $27,000 for wages and salaries paid operating personnel.

In addition to the direct area redevelopment benefits from wages and salaries paid during construction and for operating personnel, indirect benefits would accrue from expanding industrial employment opportunities as a result of insuring adequate water supplies for present operation and future expansion of plants presently located in the area.

<u>Intangible benefits</u>. Benefits other than those assigned a monetary value would follow construction of the proposed Bowie project. The possibility of loss of life from floods would be lessened in the reservoir area and downstream of the project, particularly at Hattiesburg and in the bridge crossing areas which are subject to inundation and washout. The project would improve sanitary conditions, which

sometimes become hazardous during prolonged periods of highwater because of infiltration of flood waters into wells and creation of additional mosquito breeding grounds. The transportation system serving the area would be relieved of schedule interruptions, thereby eliminating considerable inconvenience in addition to the monetary losses. The potential for industrial expansion and a general economic upswing would be increased by the provision of an adequate water supply. The scenic improvements in the reservoir area and the availability of fresh-water recreational opportunities would enhance the lands adjacent to the proposed reservoir and immediately downstream from the project, thereby causing an increase in real estate values.

Benefit summary. The total average annual benefits attributable to the Bowie project purposes would be $3,085,000, of which $2,076,000 would accrue to the initial project and $1,009,000 to the delayed works. A summary of these benefits is given in Table 20. Area redevelopment benefits equivalent to $216,000 per year over the life of the project, would increase the total average annual benefits to $3,301,000.

COMPARISON OF BENEFITS AND COSTS

The total annual benefits of $3,085,000 for the Bowie project, excluding economic redevelopment benefits, would exceed the average annual cost of $947,000, giving a benefit-to-cost ratio of 3.3. Including $216,000 annually for the economic redevelopment benefits would increase the ratio to 3.5.

MIZE RESERVOIR

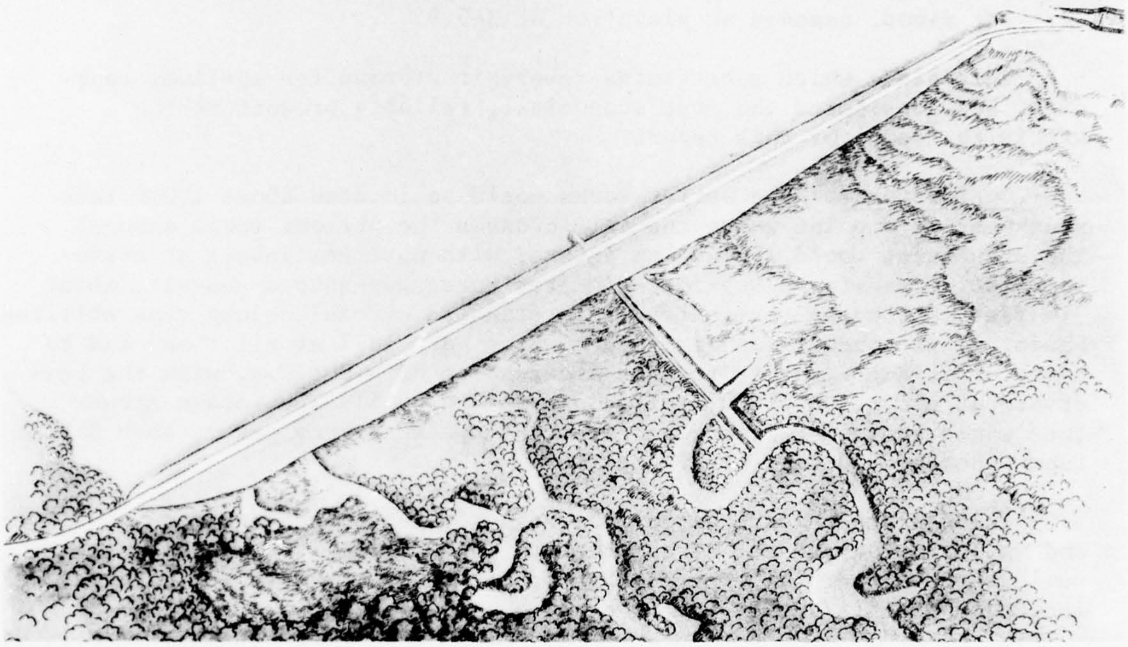
GENERAL

The Oakohay Creek, from its source near the Pearl-Pascagoula drainage basin divide in Scott County, Mississippi, flows generally southward to enter the Leaf River near mile 117.5, about 39 river miles above Hattiesburg. The Oakohay Creek basin has a maximum length of about 40 miles and a maximum width of 8 miles. The Mize dam would be located on Oakohay Creek at approximate stream mile 28, in southwest Smith County. The drainage area above the site is 150 square miles, about 66 percent of the Oakohay Creek drainage basin. The reservoir would extend about 6 miles upstream from the dam and would have a maximum width of about 1.5 miles at full conservation pool elevation 316.0.

The plan for the Mize project includes an earth dam, a high-level fixed-crest emergency spillway, an intake structure and an outlet conduit with a stilling basin. An artist's conception of the project is shown in Figure 19.

Figure 19

Artist's conception of Mize Dam



PROJECT PLAN

Dam. The earth dam would be 5,200 feet long and have a maximum height of 64.5 feet. The top of dam at elevation 350.5 would provide a 4.6-foot freeboard above the spillway design flood pool and a 21.5-foot freeboard above the elevation of the full flood control pool. The top width of the dam would be 18.0 feet, providing ample width for a 12-foot-wide service road. The slope of the upstream face of the dam would be 1 vertical on 4 horizontal from the base to elevation 334.8, 1 vertical on 2.5 horizontal from elevation 334.8 to the top and would be covered by riprap. The downstream slope of the dam would be 1 vertical on 3 horizontal and would not require riprapping. Instead, the downstream slope and the portion of the top of dam not covered by the service road would be grassed.

Spillway. The emergency spillway would be cut through a narrow ridge about 1,100 feet northeast of the left abutment of the dam, and

would consist of an unpaved free-overflow section having a 1,000-foot-long crest at elevation 340.0, which would be 5.2 feet above the standard project flood pool elevation. The length and crest elevation of the spillway selected would fit the topography without requiring an excessive amount of excavation. Normal operation of the reservoir would limit the use of the spillway to floods larger than 68 percent of the spillway design flood series. The spillway design flood, when routed through the reservoir on an initial pool equal to that of the 100-year flood, reached an elevation of 345.9.

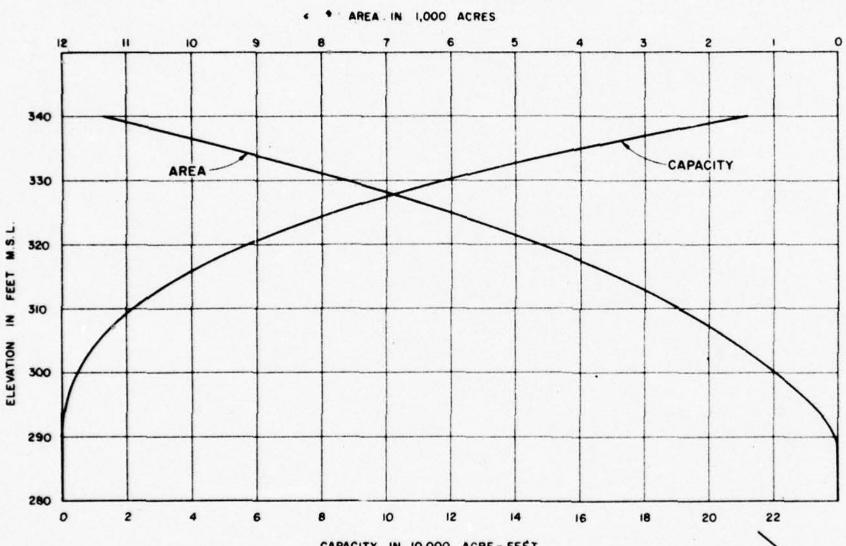
This plan, which substitutes reservoir storage for spillway capacity, was considered the most economical, reliable project design within the scope of this report.

Outlet works. The outlet works would be located about 1,000 feet southwest of a point where the axis crosses the present creek channel. The structures would include an intake, with upstream invert at elevation 286.0, serving a 9.5-foot-diameter horseshoe-shaped conduit, about 310 feet in length, terminating in a standard hydraulic-jump-type stilling basin. This conduit was designed to flow part full at all times and to have sufficient capacity to pass a discharge of 900 c.f.s. with the reservoir at elevation 316.0, full conservation pool. The intake structure would contain two service gates and two emergency gates, each 3.5 feet wide and 7.0 feet high.

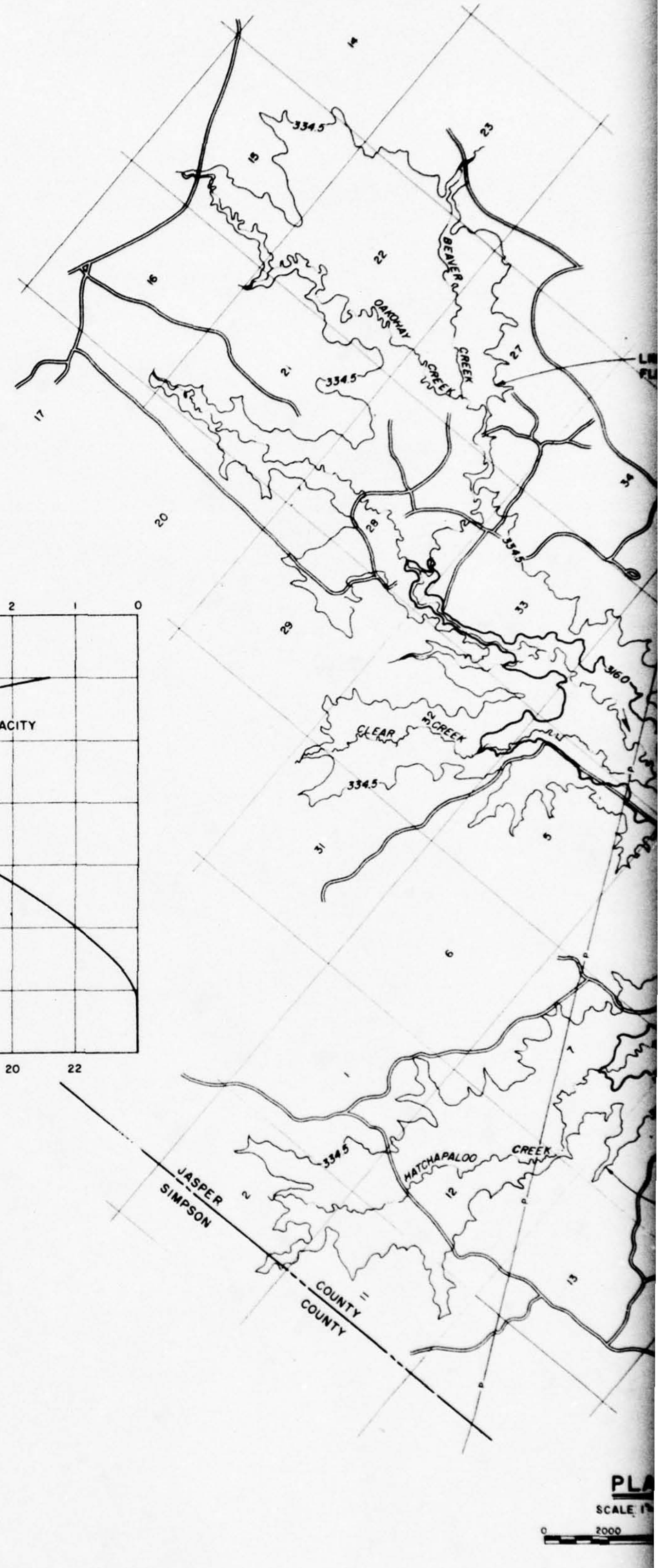
In order to release water from near the top of conservation pool and maintain the present stream quality, a high-level auxiliary outlet would be required. Allowances have been made in the cost estimate for inclusion of this outlet in the plan.

Reservoir. The Mize Reservoir would provide 70,000 acre-feet of flood control storage (8.8 inches of runoff) between elevations 316.0 and 329.0. An additional 101,000 acre-feet of storage (12.6 inches of runoff), not assigned for project purposes, would be available from elevation 329.0 to spillway crest elevation 340.0 for the storing of floods greater than the 100-year flood. Total storage to elevation 316.0 would be 40,000 acre-feet, of which 3,000 acre-feet would be for sediment accumulation below elevation 298.5 and 37,000 acre-feet between elevations 298.5 and 316.0 would be for future water resource needs and to maintain a suitable recreation pool. The reservoir would have an area of 3,600 acres at conservation pool elevation 316.0. The reservoir is shown on Figure 20.

Recreation facilities. The initial general recreation facilities for the Mize project were determined, in close cooperation, with the Bureau of Outdoor Recreation, as necessary to meet the expected needs of the project area in 1980. Included are 2 overlooks, 3 boat launching areas, 7 camping areas, 12 picnicking areas, 18 acres of swimming



AREA – CAPACITY CURVES



U. S. ARMY

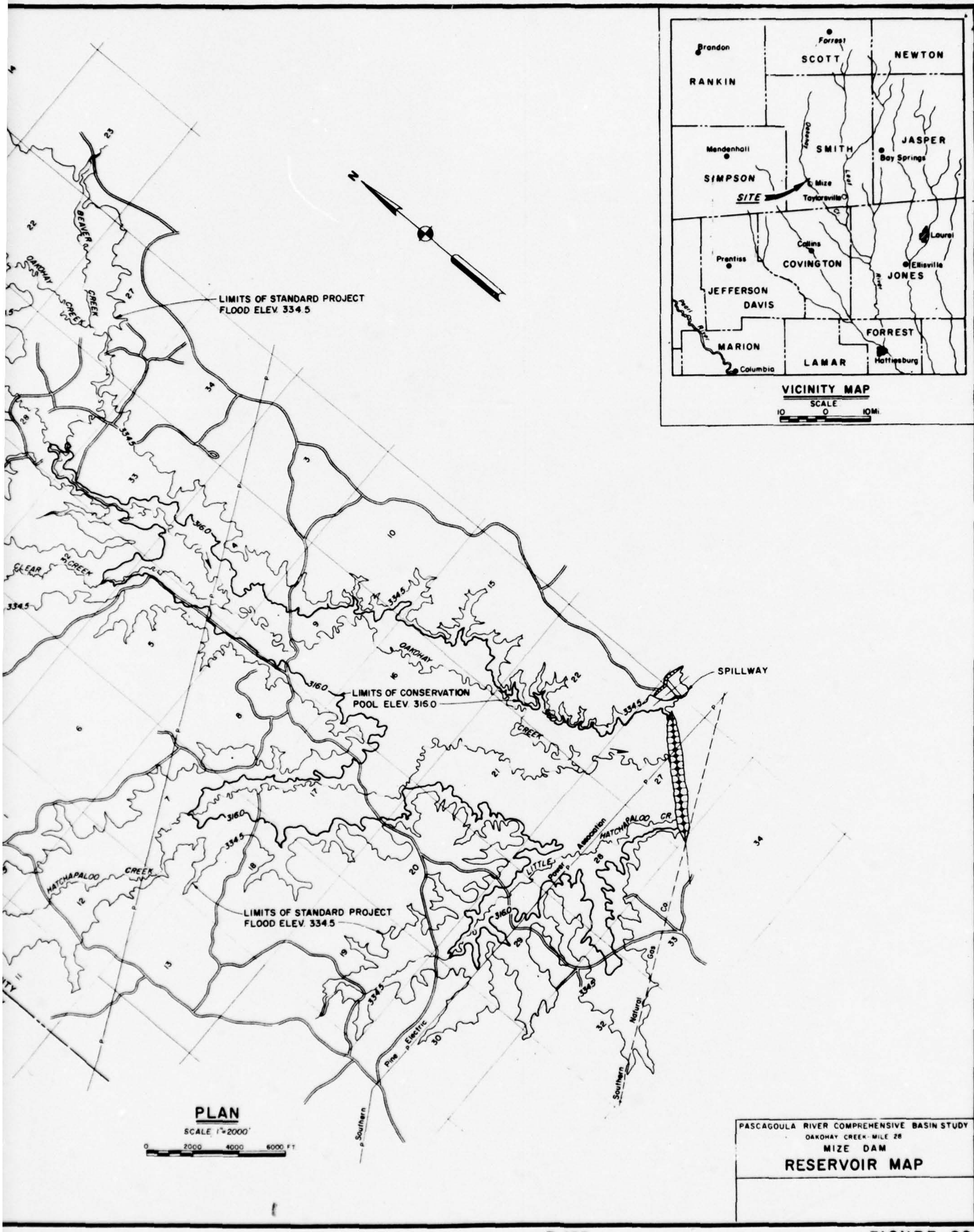


FIGURE 20

beaches, and 9 miles of hiking trails. The delayed facilities, estimated to be constructed over a 35-year period (1980-2014), are those necessary to keep pace with the projected demand. These include 20 camping areas, 18 picnicking areas, and 44 acres of swimming beaches. The Bureau of Outdoor Recreation report, presented as Appendix H, gives data relevant to the inclusion of these facilities as part of the project plan.

The requirements for reservoir and tailrace access for fish and wildlife purposes were derived in cooperation with the Bureau of Sport Fisheries and Wildlife and were based on the report of that agency contained in Appendix I. Planned fish and wildlife facilities include 2 reservoir access areas and 2 tailrace access areas.

The locations of the general recreation and fish and wildlife facilities were not set for this report and would be determined by the Corps of Engineers during the advanced planning stage following authorization of the project by the Congress.

<u>Real estate requirements</u>. The guideline for acquisition of real estate for reservoir regulation was established as the blockout, by percentage factor, of the 340-foot contour (spillway crest elevation). The area thus defined would amount to 13,000 acres, of which about 1,300 acres are cleared and the remaining 11,700 are wooded. An additional 600 acres of land would be required for specific recreational purposes. The mineral estate underlying the reservoir would be subordinated.

<u>Relocations</u>. The relocations required for the Mize Reservoir would consist of approximately 7.0 miles of State and county roads and bridges, 2.5 miles of transmission lines, 6.0 miles of utility lines and 2.0 miles of privately owned gas lines.

<u>Foundation conditions</u>. The damsite lies within the Long Leaf Pine Hills physiographic division of the Gulf Coastal Plain. The abutments rise gently to above elevation 350 m.s.l., approximately 60 feet above the flood plain. The site is underlain by the Catahoula Sandstone Formation of Miocene Age, and the abutment areas are mapped as the Citronelle Formation of Pliocene Age. Neither of these formations could be positively identified within the depths of the borings as no rock or obvious features were encountered. A preponderance of clay and clayey sand underlies the flood plain. Most of the soil from the spillway section should be suitable for use as fill material in the dam. Geologic conditions are considered favorable for construction of an earth dam at this site.

COSTS

The total initial first cost of the Mize project is estimated to be $12,800,000 and the total with delayed recreational facilities is $15,522,000. A summary of first costs of the principal features of the project is given in Table 20.

In determining the gross and net investment for the initial project, interest during construction was estimated over a 4-year period of construction, assuming equal annual expenditures of the first cost. The present worth for the value of salvageable lands at the end of the 100-year project life was ignored, thereby making the gross and net investment the same for the initial project. In determining the present worth of gross and net investment for the total project, the construction of the delayed recreation facilities was assumed to take place over a period of 35 years (1980-2014) with equal annual expenditures during this period. Interest during construction for the delayed works was not considered in the evaluation. Table 20 presents a first cost and investment summary for the Mize project.

Total annual charges for the development are estimated to be $610,000, based on a project life of 100 years (1975-2075) and using an interest rate of 3.25 percent. A summary of the annual charges is presented in Table 20.

BENEFITS

General. The Mize project would be constructed for the purposes of flood control and recreation. Recreation consists of general recreation and fish and wildlife enhancement. The tangible, intangible and area redevelopment benefits accruing to the project are discussed below. However, area redevelopment benefits and intangible benefits were not considered in determining project justification.

Flood control. Benefits attributable to flood control for this project would result from the control of the 150-square-mile drainage area above the site. This dam is one of three in a proposed system for the effective control of floods at Hattiesburg and other urban areas. This city and the other urban areas of Mize, Petal, Harvey, New Augusta, Beaumont and McLain contain 1,340 acres of land subject to inundation that would be affected by the Mize project. In addition to flood protection for the urban areas, approximately 81,300 rural flood plain acres downstream from the site would receive a varying degree of flood protection. Flood control benefits credited to the operation of this project are comprised of reduced flood losses and change in land use, both to present and future development. "Present" development was considered to be for 1975, the assumed year that benefits could begin accruing to the project.

The average annual benefit to present development is estimated to be $344,000, of which $188,000 would be rural and $156,000 urban. The estimated benefits to future development are $224,000, of which $86,000 would be to the rural area and $138,000 to the urban area. The total average annual flood control benefits for the proposed project are $568,000. No urban benefits were attributed to enhancement of land in the flood plain. The derivation of the flood control benefits are contained in Section 3 of this appendix.

Recreation. Benefits accruing to the Mize project for inclusion of recreation as a purpose were determined by agencies of the Department of the Interior, in close cooperation with the Corps of Engineers. General recreation benefits as determined by the Bureau of Outdoor Recreation are presented in Appendix H, and the benefits attributable to fish and wildlife enhancement as determined by the Bureau of Sport Fisheries and Wildlife are contained in Appendix I.

The annual visitor-day attendance at this project for general recreation activities by 1980 is 753,800, increasing to 2,143,500 by the year 2015 when the ultimate development stage is reached. Using a weighted value of $0.95 per recreation day, the benefits for the initial development stage were determined to be $716,000 in 1980. By 2015, with the installation of the delayed facilities, this would increase to $2,036,000. These benefits discounted to 1975, the assumed completion date of the initial project, would have an average annual value of $1,370,000, of which $709,000 would be due to the initial project and $661,000 due to the delayed works.

The estimated annual man-day attendance for reservoir and tailrace fishing is 19,800 in 1980 and 72,000 in 2015. An average of 360 man-days of waterfowl hunting is estimated throughout the life of the project. There would be approximately 2,700 man-days of hunting lost initially because of the inundation of the bottomlands within the reservoir area. These losses would be mitigated by making available for wildlife management those lands not needed for other project purposes. This would assure development and management of wildlife resources for maximum public benefit. The average annual benefits to fish and wildlife enhancement expected after development of the project would be $47,000.

Area redevelopment. Seven counties in Mississippi and an Indian Reservation within a 50-mile commuting distance of the proposed Mize project meet (as of October 1967) the criteria for area redevelopment assistance specified in title IV, section 401(a) of the Public Works and Economic Development Act (Public Law 89-136). The counties of Clarke, Jasper, Lawrence and Newton qualify because of excessive unemployment, and the counties of Covington, Jefferson Davis and Smith qualify because of the low median family income. The Choctaw

Reservation, in several nearby counties, qualifies by virtue of being an Indian Reservation and being recommended by the Bureau of Indian Affairs.

Area redevelopment benefits attributed to the project would result from the value of wages and salaries paid for labor during the construction period and the wages and salaries paid operating personnel for a 20-year period after completion of the initial project construction. Based on the unemployment in the area, it was assumed that essentially all labor requirements for construction of the project could be filled from within the area by the unemployed labor force, or that jobs vacated by direct hires would in turn be filled from the unemployed labor force. The values of these wages and salaries were converted to present value at the time the initial project was assumed to be completed and amortized over the 100-year project life. The average annual benefits accruing to the Mize project from area redevelopment are estimated to be $137,000, of which $113,000 would be for wages and salaries paid during construction and $24,000 for wages and salaries paid operating personnel.

Intangible benefits. Benefits other than those assigned a monetary value would follow construction of the proposed Mize project. The possibility of loss of life from floods would be lessened in the reservoir area and downstream of the project, particularly at Hattiesburg and in the bridge crossing areas which are subject to inundation and washout. The project would improve sanitary conditions, which sometimes become hazardous during prolonged periods of high-water because of infiltration of flood waters into wells and creation of additional mosquito breeding grounds. The transportation systems serving the area would be relieved of schedule interruptions, thereby eliminating considerable inconvenience in addition to the monetary losses. The scenic improvements in the reservoir area and the availability of fresh-water recreational opportunities would enhance the lands adjacent to the proposed reservoir and immediately downstream from the project, thereby causing an increase in real estate values.

Benefit summary. The total average annual benefits attributable to the Mize project purposes would be $1,985,000, of which $1,324,000 would accrue to the initial project and $661,000 to the delayed works. A summary of these benefits is given in Table 20. Area redevelopment benefits, equivalent to $137,000 per year over the life of the project, would increase the total average annual benefits to $2,122,000.

COMPARISON OF BENEFITS AND COSTS

The total annual benefits of $1,985,000 for the Mize project, excluding economic redevelopment benefits, would exceed the average annual cost of $610,000, giving a benefit-to-cost ratio of 3.3. Including $137,000 annually for the economic redevelopment benefits would increase the ratio to 3.5.

HARLESTON RESERVOIR

GENERAL

The Escatawpa River rises in southwest Alabama and flows generally south into the extreme southeastern portion of Mississippi to join the Pascagoula River in the estuary area near Pascagoula, Mississippi. It drains an area of about 1,060 square miles. The basin has a maximum length of about 80 miles and width of 20 miles. The Harleston Dam would be located approximately at river mile 42 at the George-Jackson County line in Mississippi. This site is about 25 miles west of Mobile, Alabama. The drainage area at the site is approximately 583 square miles, or about 55 percent of that of the Escatawpa River Basin. At full conservation pool elevation 85.5 m.s.l., the reservoir would extend some 20 miles upstream from the dam and about 9 miles into Alabama. It would have a maximum width of about 2 miles.

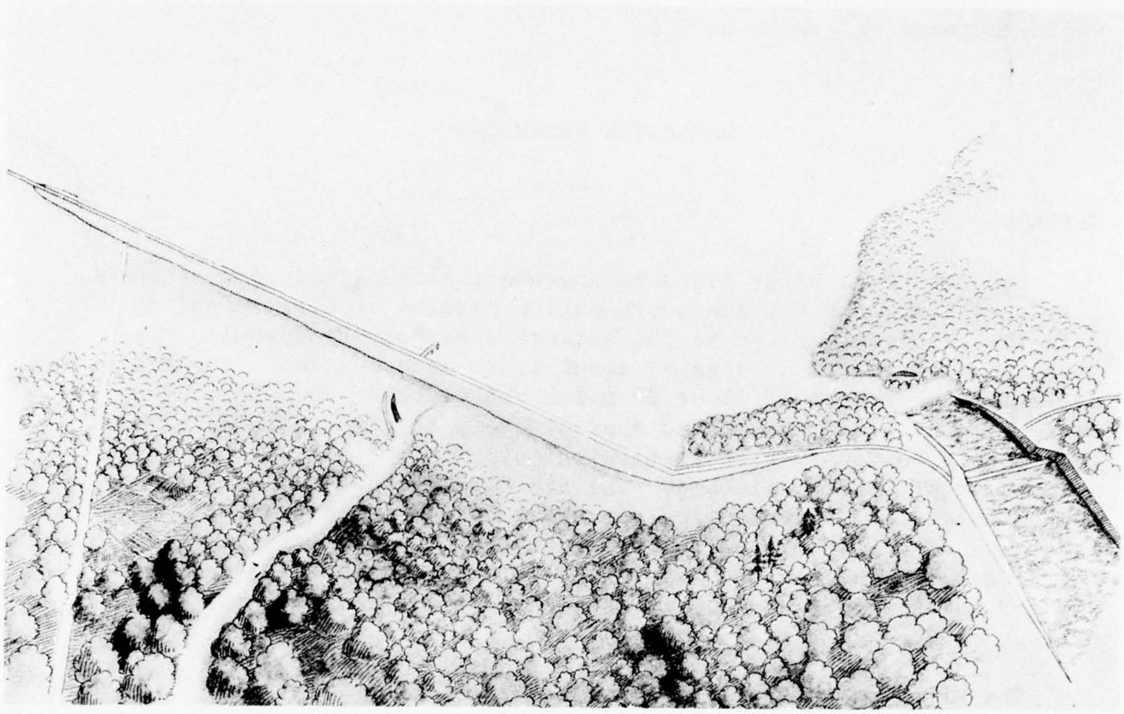
The plan for the Harleston project includes an earth dam, a high-level, fixed-crest spillway, an intake structure and an outlet conduit with a stilling basin. An artist's conception of the project is shown in Figure 21.

PROJECT PLAN

Dam. The earth dam would be 13,700 feet long and have a maximum height of 80 feet. The top of dam at elevation 125.0 would provide a 4.9-foot freeboard above the spillway design flood pool and a 23.5-foot freeboard above full flood control pool. The top width of the dam would be 18.0 feet, providing ample room for a 12-foot-wide service road. The upstream and downstream slopes would be 1 vertical on 3 horizontal. The upstream slope would be covered by riprap while the downstream slope and the portion of the top of dam not covered by the service road would be grassed.

Figure 21

Artist's conception of Harleston Dam



Spillway. The emergency spillway would be cut through a narrow ridge about 1,500 feet northeast of the left abutment of the dam and would consist of an unpaved, free-overflow section having a 1,300-foot-long crest at elevation 114.0, which would be 7.9 feet above the standard project flood pool elevation. The length and crest elevation of the spillway would fit the topography without requiring an excessive amount of excavation. Normal operation of the reservoir would limit the use of the spillway to floods larger than 57 percent of the spillway design flood series. The spillway design flood, when routed through the reservoir on an initial pool equal to that of the 100-year flood, reached an elevation of 120.1.

This plan, which substitutes reservoir storage for spillway capacity, was considered the most economical, reliable project design within the scope of this report.

Outlet works. The outlet works would be located about 500 feet west of the present river channel. The structures would include an intake, with upstream invert at elevation 45.0, serving an 11-foot-diameter horseshoe-shaped conduit, about 370 feet in length, terminating in a standard hydraulic-jump-type stilling basin. The conduit was designed to flow part-full at all times and to have sufficient capacity to pass a discharge of 3,000 c.f.s. with the reservoir at elevation 85.5, full conservation pool. The intake structure would contain 2 service gates, 4.5 feet wide by 8 feet high, and 2 emergency gates of the same size. In order to release water from near the top of conservation pool for water quality purposes, an auxiliary outlet would be required. Allowances have been made in the cost estimate for the inclusion of this outlet.

Reservoir. The Harleston Reservoir at full conservation pool elevation 85.5 would have an area of 15,900 acres. The average area of the pool during the recreation season would be about 14,000 acres. At elevation 85.5 the reservoir would contain 275,500 acre-feet of storage, of which 16,700 acre-feet would be for sediment accumulation for a 100-year period, 30,300 acre-feet for water supply and 228,500 acre-feet for lowflow augmentation for water quality improvement in the Escatawpa estuary in the Moss Point-Pascagoula area. Flood control storage of 323,300 acre-feet (equivalent to 10.4 inches of runoff) would be available between elevation 85.5 and elevation 101.5. Additional storage of 366,200 acre-feet, or 11.8 inches of runoff, not assigned for project purposes, would be available to spillway crest elevation 114.0. The reservoir is shown on Figure 22.

Recreation facilities. The initial general recreation facilities for the Harleston project were determined, in close cooperation with the Bureau of Outdoor Recreation, as necessary to meet the expected needs of the area in 1980. Included are 2 overlooks, 10 boat launching areas, 27 camping areas, 47 picnicking areas, 72 acres of swimming beaches, and 14 miles of hiking trails. The delayed facilities, estimated to be constructed over a 35-year period (1980-2014), are those necessary to keep pace with the projected demand. These include 80 camping areas, 71 picnicking areas, and 172 acres of swimming beaches. The Bureau of Outdoor Recreation report, presented as Appendix H, gives data relevant to the inclusion of these facilities as part of the project plan.

The requirements for reservoir and tailrace access for fish and wildlife purposes were derived in cooperation with the Bureau of Sport Fisheries and Wildlife and were based on the report of that agency contained in Appendix I. Planned fish and wildlife facilities include 4 reservoir access areas and 4 tailrace access areas.

The locations of the general recreation and fish and wildlife facilities were not set for this report and would be determined by the Corps of Engineers during the advanced planning stage following authorization of the project by the Congress.

Water supply structures. Intakes, pumps and conduit for municipal and industrial water would be constructed by local interests apart from the project structures and are not covered in this report.

Real estate requirements. The guideline for acquisition of real estate for reservoir regulation was established as the blockout, by percentage factor, of the 114-foot contour (spillway crest elevation). The area thus defined would amount to 37,600 acres, of which about 5,600 acres are cleared and the remaining 32,000 are wooded. An additional 500 acres of land would be needed for specific recreational purposes. The full mineral estate would be acquired.

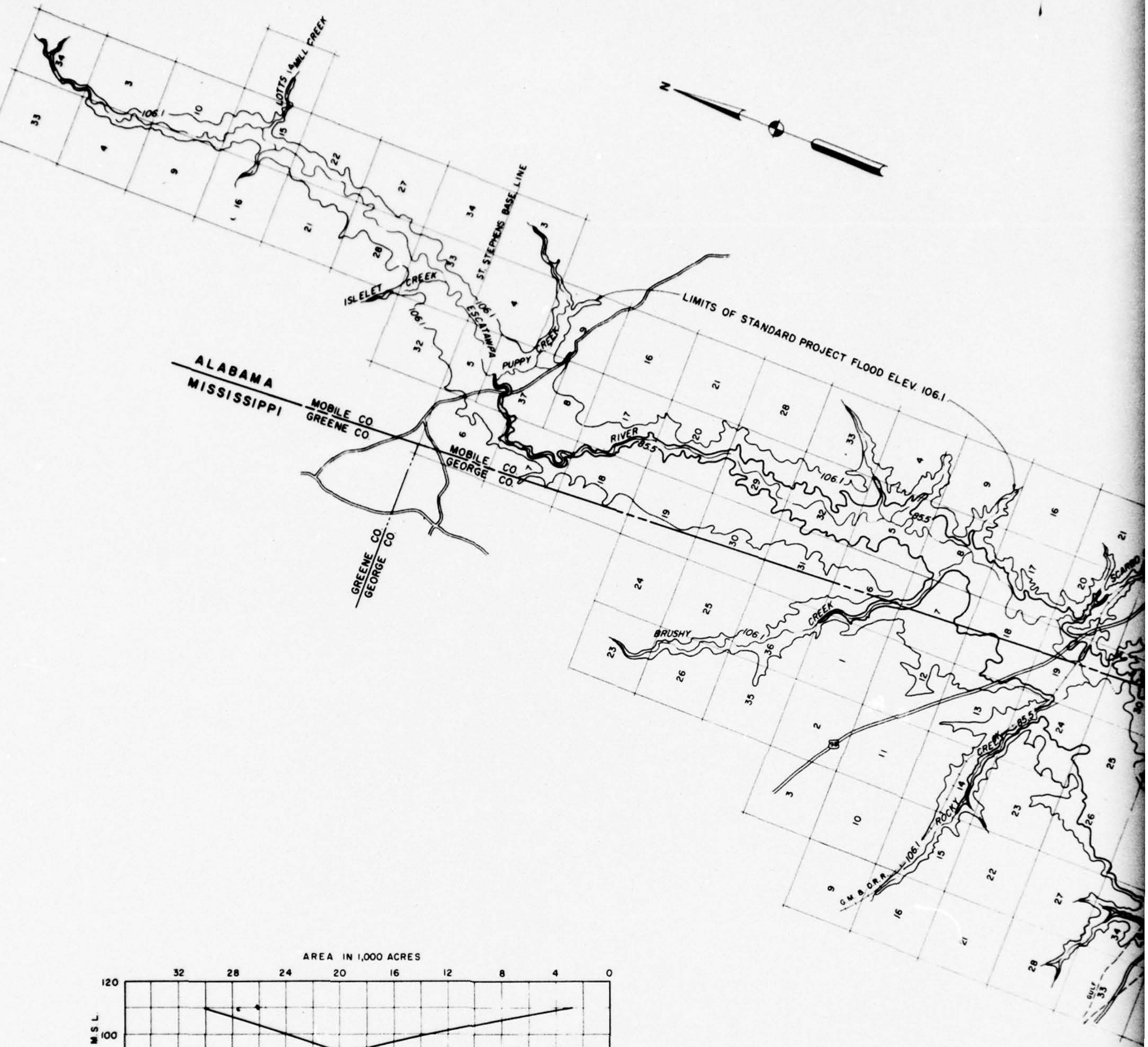
Relocations. Approximately 1.6 miles of Federal highways, 11.3 miles of county roads, 4.8 miles of railroads, and 14 bridges, including a Federal highway bridge and a railroad bridge, would have to be relocated. Additional relocations would include 7.2 miles of utility lines and 8.9 miles of privately owned gas lines.

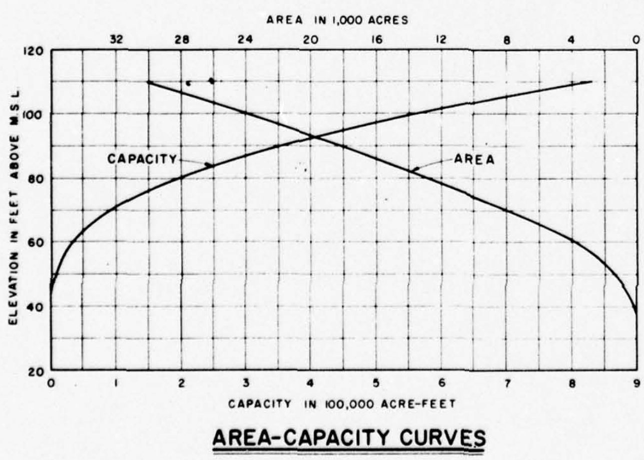
Foundation conditions. The damsite is located along the southern edge of the Long Leaf Pine Hills physiographic division of the Gulf Coastal Plain. The abutments rise gently to about elevation 130 m.s.l., approximately 80 feet above the flood plain. The site is underlain by the Citronelle Formation of Pliocene Age, covered by a veneer of alluvial material consisting mostly of silty and clayey sands. Most of the soils from the spillway section are suitable for use as fill material in the dam. Geologic conditions are favorable for construction of an earth dam at this site.

COSTS

The total initial first cost of the Harleston project is estimated to be $46,500,000 and the total with delayed recreational facilities is $56,959,000. A summary of first costs of the principal features of the project is given in Table 20.

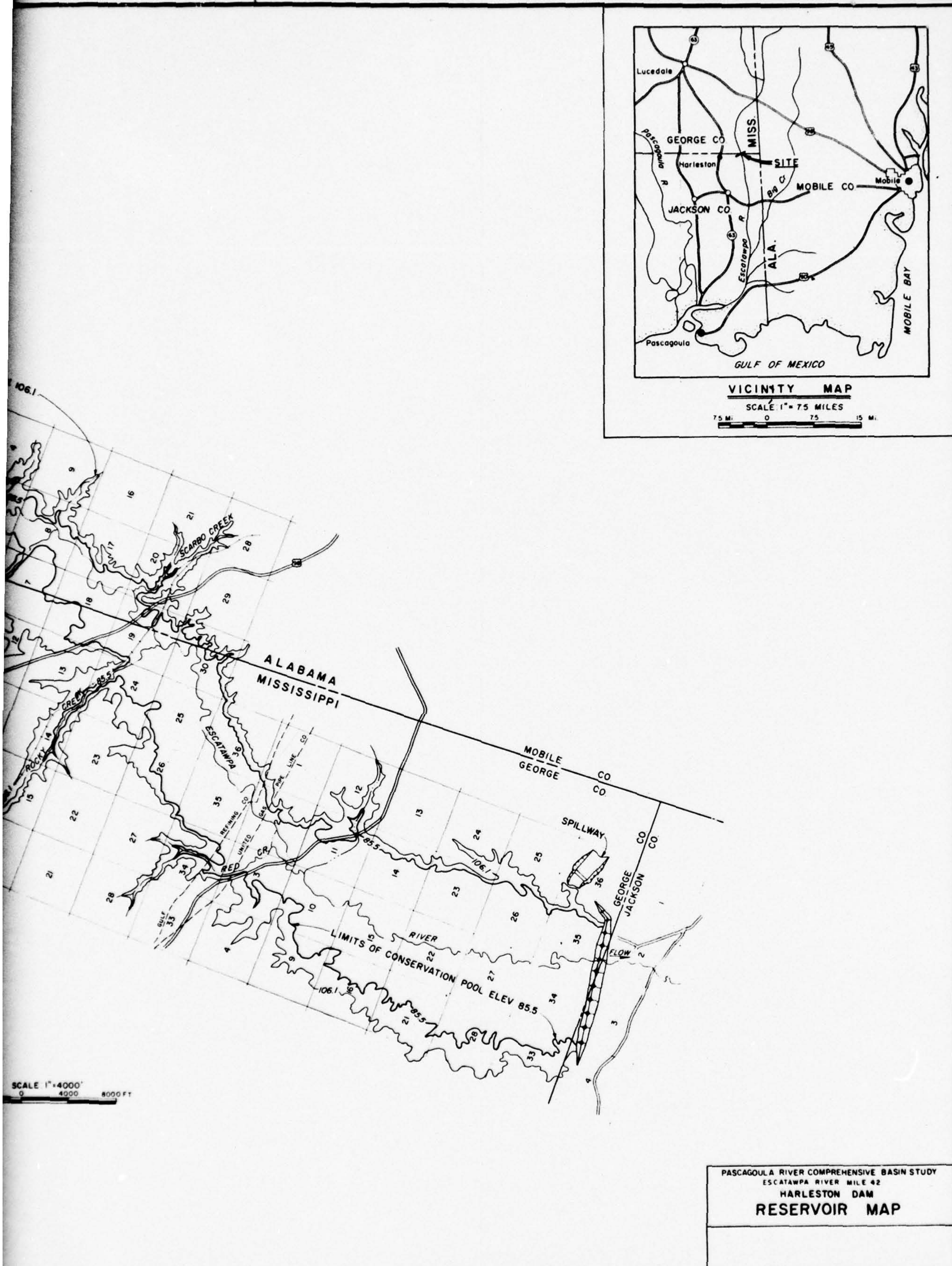
In determining the gross and net investment for the initial project, interest during construction was estimated over a 5-year period of construction, assuming equal annual expenditures of the first cost. The present worth for the value of salvageable lands at the end of the 100-year project life was ignored, thereby making the gross and net investment the same for the initial project. In determining the present worth of gross and net investment for the total project, the construction of the delayed recreation facilities





AREA-CAPACITY CURVES

2



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY
ESCATAWPA RIVER MILE 42
HARLESTON DAM
RESERVOIR MAP

FIGURE 22

was assumed to take place over a period of 35 years (1980-2014) with equal annual expenditures during this period. Interest during construction for the delayed works was not considered in the evaluation. Table 20 presents a first cost and investment summary for the Harleston project.

Total annual charges for the development are estimated to be $2,206,000, based on a project life of 100 years (1975-2075) and using an interest rate of 3.25 percent. A summary of the annual charges is presented in Table 20.

BENEFITS

General. The Harleston project would be constructed for the purposes of flood control, water quality control, water supply and recreation. Recreation consists of general recreation and fish and wildlife enhancement. The tangible, intangible and area redevelopment benefits accruing to the project are discussed below. However, area redevelopment benefits and intangible benefits were not considered in determining project justification.

Flood control. Benefits attributable to flood control for this project would result from the control of the runoff from the 583-square-mile drainage area above the site. The reduction in flood stages would allow residential and commercial development downstream for about 14 miles. However, benefits were evaluated for reduced rural damages only, as no urban area is significantly affected and no material change in land use was assumed. The estimated average annual flood control benefits to this project are $36,000, of which $25,000 are to present development and $11,000 to future development. The derivation of the flood control benefits is given in Section 3 of this appendix.

Water quality control. The project would provide 228,500 acre-feet of storage to supplement low flows of the Escatawpa River. The benefit attributable to this low flow augmentation, as derived by the Federal Water Pollution Control Administration and confirmed by the Corps of Engineers, is estimated to be $940,000 annually. This benefit was considered equal to the annual charges for construction and operation of an interceptor system with an ocean outfall, the least-cost alternative for providing a solution to the pollution problem. A discussion of this alternative and the method and analysis of arriving at the benefit for the water quality control is presented in Appendix G. Due to the immediate need for streamflow regulation, this benefit was not discounted.

Water supply. The benefit for providing 30,300 acre-feet of storage for municipal and industrial water supply was also determined by

the Federal Water Pollution Control Administration, and confirmed by the Corps of Engineers. This storage is equivalent to 100 million gallons per day during the life of the project. The least-cost alternative for providing this supply was the annual cost of withdrawal and transportation of a like amount from the Pascagoula River to supply the needs in the Pascagoula-Moss Point area. The annual cost for this alternative was estimated to be $460,000, which was considered as the average annual benefit for this purpose. The alternatives considered for water supply and the derivations of the benefits are presented in Appendix G.

Recreation. Benefits accruing to the Harleston project for inclusion of recreation as a purpose were determined by agencies of the Department of the Interior, with close cooperation by the Corps of Engineers. General recreation benefits as determined by the Bureau of Outdoor Recreation are presented in Appendix H, and the benefits attributable to fish and wildlife enhancement, as determined by the Bureau of Sport Fisheries and Wildlife, are contained in Appendix I.

The annual visitor-day attendance expected at this project for general recreation activities by 1980 is 2,931,400, increasing to 8,335,850 by the year 2015 when the ultimate development stage is reached. Using a weighted value of $0.95 per recreation day, the benefits for the initial development stage were determined to be $2,785,000 in 1980. By 2015, with the installation of the delayed facilities, this would increase to $7,919,000. These benefits discounted to 1975, the assumed completion date of the initial project, would have an average annual value of $5,329,000, of which $2,759,000 would be due to the initial project and $2,570,000 due to the delayed works.

The estimated annual man-day attendance for reservoir and tailrace fishing is 77,000 in 1980 and 280,000 in 2015. An average of 1,400 man-days of waterfowl hunting is estimated throughout the life of the project. There would be approximately 10,500 man-days of hunting lost initially because of the inundation of the bottomlands within the reservoir area. These losses would be mitigated by making available for wildlife management those lands not needed for other project purposes. This would assure development and management of wildlife resources for maximum public benefit. The average annual benefit to fish and wildlife enhancement due to development of the total project would be $183,000.

Area redevelopment. Two urban areas within a 50-mile commuting distance of the proposed Harleston Reservoir meet (as of October 1967) the criteria for area redevelopment assistance specified in title IV, section 401(a), of the Public Works and Economic Development Act (Public Law 89-136). Leakesville, Mississippi (Greene County) meets the criteria for qualification because of excessive unemployment and

low median family income in 1960. Lucedale, Mississippi (George County) qualifies because of excessive unemployment. Another urban area, Richton, Mississippi (Perry County) meets the criteria for qualification under title I, section 102, of the Act.

Area redevelopment benefits attributed to the project would result from the value of wages and salaries paid to workers during the construction period, and the value of wages and salaries paid operating personnel for a 20-year period after construction of the initial project is completed. Based on the unemployment in the area, it was assumed that essentially all labor requirements for construction of the project could be filled from within the area by the unemployed labor force or that jobs vacated by direct hires would in turn be filled from the unemployed labor force. These values were converted to present values at the time the initial project was assumed to be completed and amortized over the 100-year life of the project. The average annual benefits accruing to the Harleston project for area redevelopment would be $498,000, of which $450,000 would be from construction and $48,000 from operation and maintenance.

In addition to these benefits from wages and salaries paid unemployed workers, indirect benefits would accrue from expanding industrial employment opportunities as a result of insuring adequate water supplies for present operations and expansion of plants presently located in the area.

Intangible benefits. Benefits other than those assigned a monetary value would follow construction of the proposed Harleston project. The possibility of loss of life from floods would be lessened in the reservoir area and downstream of the project, particularly in the bridge crossing areas which are subject to inundation and washout. The project would improve sanitary conditions, which sometimes become hazardous during prolonged periods of highwater because of infiltration of flood waters into wells and creation of additional mosquito breeding grounds. The transportation systems serving the area would be relieved of schedule interruptions, thereby eliminating considerable inconvenience in addition to the monetary losses. The potential for industrial expansion and a general economic upswing would be increased by the provision of adequate water supply and pollution abatement. The scenic improvements in the reservoir area and the availability of fresh-water recreational opportunities would enhance the lands adjacent to the proposed reservoir and immediately downstream from the project, thereby causing an increase in real estate values.

Benefit summary. The total average annual benefits attributable to the Harleston project purposes would be $6,948,000, of which $4,378,000 would accrue to the initial project and $2,570,000 to the delayed works. A summary of these benefits is given in Table 20.

Area redevelopment benefits, equivalent to $498,000 per year over the life of the project, would increase the total average annual benefits to $7,446,000.

COMPARISON OF BENEFITS AND COSTS

The total annual benefits of $6,948,000 for the Harleston project, excluding economic redevelopment benefits, would exceed the average annual cost of $2,206,000, giving a benefit-to-cost ratio of 3.1. Including $498,000 annually for the economic redevelopment benefits would increase the ratio to 3.4.

SECTION 5 — SUPPLEMENTAL DATA

PART A — NAVIGATION STUDIES

PURPOSE AND SCOPE

Purpose. The objective of the studies was to determine justification of providing channels suitable for modern barge navigation from Pascagoula to Hattiesburg on the Leaf River; Laurel on Tallahala Creek, a tributary of the Leaf River; and Meridian on Okatibbee Creek, a tributary of the Chickasawhay River. Local interests have designated the navigation project under consideration as "The Pat Harrison Waterway."

Scope. Studies included review of previous navigation reports, canvass of shippers and receivers of freight in the tributary area to determine the present traffic flow pattern, a freight rate analysis to develop information on commerce that could reasonably be expected to move on the waterways at a savings in transportation charges, and preliminary cost estimates of improvements for barge navigation. Engineering studies were based on an aerial mosaic of the Pascagoula River, prepared from 1958 photographs, maps of the Leaf and Chickasawhay Rivers and Tallahala and Okatibbee Creeks prepared in 1964 from aerial photographs, a 1963 hydrographic survey of the Pascagoula River, 1964 flood plain profiles of the river system, U. S. Geological Survey quadrangle sheets, and U. S. Army Map Service strategic maps.

EXISTING NAVIGATION PROJECTS

The existing project for the Pascagoula River provides for maintenance of the natural channel, by removal of obstructions, from the junction with Dog (Escatawpa) River near Pascagoula, to Merrill, a distance of 75 miles. No project depth was specified in the authorizing act. Controlling depth during low water is about 7 feet from the mouth of Escatawpa River to Dead Lake, a distance of about 37 miles, and about 3 feet from Dead Lake to Merrill. The project was authorized by the River and Harbor Act of 3 March 1899, and prior acts.

The existing project for Pascagoula Harbor, as authorized by the 1963 River and Harbor Act and prior acts, provides for: (a) an entrance channel 40 feet deep and 350 feet wide from the Gulf of Mexico through Horn Island Pass, including an impounding area for littoral drift, 40 feet deep, 200 feet wide and about 1,500 feet long, adjacent to the channel at the west end of Petit Bois Island; (b) a channel 38 feet deep and 350 feet wide in Mississippi Sound and Pascagoula River to the railroad bridge at Pascagoula, including a turning basin 2,000 feet long and 950 feet wide (including channel area) on the west side of the

river below the railroad bridge; (c) a channel 38 feet deep and 225 feet wide from the ship channel in Mississippi Sound to the mouth of Bayou Casotte, thence 38 feet deep and 300 feet wide for about 1 mile to a turning basin 1,000 feet wide and 1,750 feet long; (d) a 22- by 150-foot channel on the Pascagoula River from the railroad bridge to the mouth of Dog River (Escatawpa River), thence up Dog River (Escatawpa River) to the Highway 63 bridge; and (e) a 12- by 125-foot channel from the Highway 63 bridge, via Robertson and Bounds Lakes, to about mile 6 on Dog River (Escatawpa River).

The Gulf Intracoastal Waterway, a 12- by 125-foot Federal project completed between Carrabelle, Florida, and Brownsville, Texas, traverses Mississippi Sound 6 miles offshore from Pascagoula. This waterway provides connection with numerous other improved inland waterways.

There are extensive terminal facilities for both deep and shallow draft vessels at Pascagoula and at Bayou Casotte. Terminal facilities along the Pascagoula River above the mouth of the Escatawpa River consist only of natural landings.

PRIOR NAVIGATION REPORTS

Navigation studies were included in 12 reports which have been submitted on all or parts of the river system, excluding Pascagoula Harbor. The most pertinent to this study is the preliminary examination of the Pascagoula, Leaf, and Chickasawhay Rivers submitted to Congress on 27 July 1951. That report concluded that improvement of the river for navigation purposes with upstream limits at Meridian, Hattiesburg, and Laurel, in whole or in part, was not economically justified and recommended that no detailed survey report be made at that time.

NAVIGATION PROBLEMS AND SOLUTIONS CONSIDERED

General. A minimum depth of 9 feet, comparable to other feeders to the Gulf Intracoastal Waterway, would be required in the Pascagoula River system to attract modern barge service and effect a reduction in transportation charges sufficient to divert traffic from other methods or routes of transportation. Channel width should be sufficient to permit two-way navigation for as long a reach as practicable.

From the mouth of the Pascagoula River to Hattiesburg on the Leaf River, a distance of about 152 miles, the difference in elevation is approximately 125 feet. From mile 47 on the Leaf River to Laurel on Tallahala Creek, about 47 miles, the rise is approximately 108 feet. The length of the Chickasawhay River and Okatibbee Creek route to Meridian is 177 miles, with a rise of about 220 feet. Studies of stream flow

records and other characteristics of the rivers indicate that it would be physically impracticable to provide a dependable 9-foot-deep channel by open river methods above about mile 47 on the Pascagoula River, even with flow augmentation from storage reservoirs. Hence, above mile 47 canalization would be the only practicable means of providing a dependable navigation channel to Hattiesburg, Laurel and Meridian.

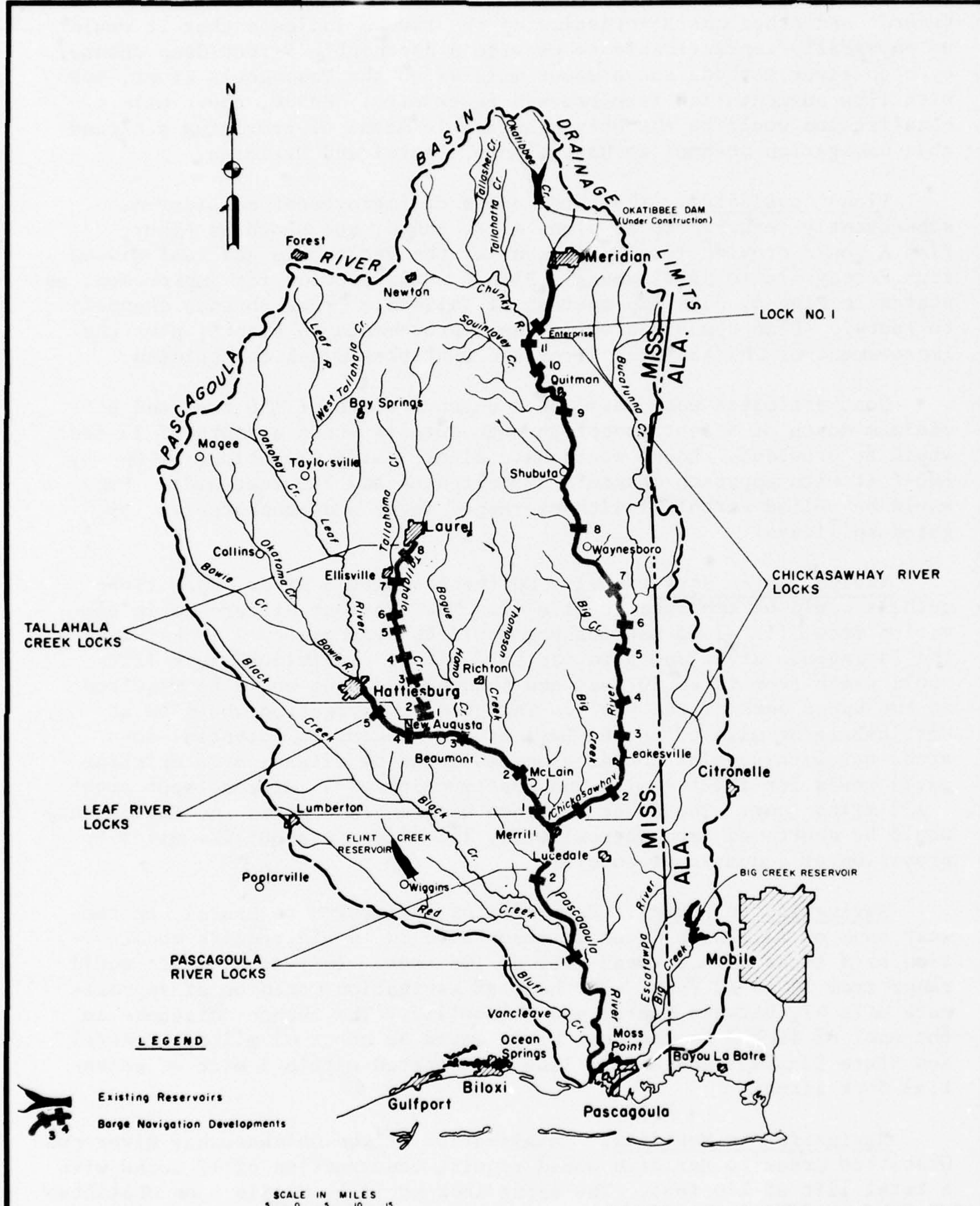
Plans considered. The three plans of improvement considered, subsequently referred to as plans A, B, and C, are shown on Figure 23. Plan A would provide for improvement of the Pascagoula and Leaf Rivers from Pascagoula to Hattiesburg. Plan B would provide for improvement as stated in Plan A, plus improvement of Tallahala Creek (branch channel) to Laurel. Plan C would provide the improvements in Plan B, plus the improvement of Chickasawhay River and Okatibbee Creek to Meridian.

Cost estimates were based on a channel width of 150 feet and a minimum depth of 9 feet except through cutoffs where a depth of 12 feet would be provided. Locks would have clear inside dimensions of 84- by 600-feet with approach channels 12 feet deep and 240 feet wide. Dams would be rolled earthfill with riprapped faces and concrete-gravity, gated spillways.

Navigation to Hattiesburg. On the Pascagoula River, open river methods would be employed to mile 47. The 125-foot difference in elevation from mile 47 to Hattiesburg would be overcome by 7 locks; 2 in the Pascagoula River and 5 in the Leaf River. Individual lock lifts would range from 10 to 20 feet and channel dredging would be required at the upper ends of the pools. The head of navigation would be at Hattiesburg at mile 69 on the Leaf River. Access to potential dock areas below this point could be accomplished by extension of existing paved roads for about 1 mile and construction of a railroad spur about 1-1/2 miles long. The river distance between Pascagoula and Hattiesburg would be shortened from approximately 152 miles to about 127 miles by provision of a number of cutoffs.

Navigation to Laurel. Extension of navigation to Laurel, on the west bank of Tallahala Creek at about mile 53, would require construction of 8 locks with a total lift of 108 feet. Individual lifts would range from 12 to 20 feet. The head of navigation would be at approximate mile 47, between Laurel and Ellisville. The channel distance to the pool of lock 3 on the Leaf River would be about 41 miles. Federal and State Highways and a rail line are located within 1 mile of potential dock sites.

Navigation to Meridian. Canalization of the Chickasawhay River and Okatibbee Creek to Meridian would require construction of 12 locks with a total lift of 220 feet. The upper lock would be at mile 4 on Okatibbee Creek and would extend navigation to the southern outskirts of town.



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

CONSIDERED WATERWAY SYSTEMS

FIGURE 23

The remaining 11 locks would all be on the Chickasawhay River. One locksite, near Waynesboro, has hydroelectric power potential. Total channel distance from the head of navigation to the confluence of the Leaf and Chickasawhay Rivers would be about 151 miles. The Gulf, Mobile and Ohio Railroad crosses Okatibbee Creek at the head of navigation and U. S. Highway 11 is about 1 mile beyond that point.

RELOCATIONS

A waterway to Hattiesburg would require alterations to 9 highway bridges, 1 railroad bridge, and 21 pipeline and utility crossings. The branch channel to Laurel would require alterations to 10 highway bridges and 6 pipeline and utility crossings. The branch channel to Meridian would involve alterations to 19 highway bridges, 3 railroad bridges, and 16 pipeline and utility crossings.

LANDS

Construction of the waterway would require fee acquisition of 1,500 acres and flowage easements on 26,000 acres along the Pascagoula and Leaf Rivers, fee acquisition of 2,800 acres and flowage easements on 210 acres along Tallahala Creek, and fee acquisition of 10,800 acres and flowage easements on about 1,000 acres along the Chickasawhay River and Okatibbee Creek.

COSTS

Initial costs and annual charges for the three plans considered are shown in Tables 21 through 23 and are summarized in Table 24.

Table 21

Initial cost and annual charges
Waterway on Pascagoula-Leaf Rivers to Hattiesburg
(1965 price level)

Item No.	Description	Cost
	INITIAL COST	
01	Lands and damages	$ 3,135,000
02	Relocations	18,665,000
03	Reservoirs (clearing)	4,000,000
04 & 05	Dams and locks	97,700,000
09	Channels and canals	12,870,000
19	Buildings, grounds and utilities	203,000
20	Permanent operating equipment	322,000
	Contingencies (20%)	27,391,000
30	Engineering and design	8,217,000
31	Supervision and administration	11,504,000
	Subtotal	184,007,000
	Aids to navigation	60,000
	GRAND TOTAL	184,067,000
A.	Project net cost	184,067,000
	Interest during construction	28,760,000
B.	Gross investment	212,827,000
	Net salvage value of land	2,640,000
C.	Net investment	210,187,000
	ANNUAL CHARGES	
a.	Interest (3-1/8%) on gross investment	6,650,000
b.	Amortization of net investment (50-year)	1,795,000
c.	Operation and maintenance	800,000
d.	Allowance for major replacements	100,000
e.	Adjustment for net loss or productivity of land (addition)	160,000
f.	Maintenance of navigation aids	15,000
g.	O. & M. - Bridges	100,000
	TOTAL ANNUAL CHARGES	9,620,000

Table 22

Initial cost and annual charges
Waterway on Tallahala Creek to Laurel
(1965 price level)

Item No.	Description	Cost
	INITIAL COST	
01	Lands and damages	$ 356,000
02	Relocations	18,130,000
03	Reservoirs (clearing)	1,130,000
04 & 05	Dams and locks	75,600,000
09	Channels and canals	2,804,000
19	Buildings, grounds and utilities	229,000
20	Permanent operating equipment	364,000
	Contingencies (20%)	19,723,000
30	Engineering and design	5,917,000
31	Supervision and administration	8,284,000
	Subtotal	132,540,000
	Aids to navigation	16,000
	GRAND TOTAL	132,556,000
A.	Project net cost	132,556,000
	Interest during construction	10,355,000
B.	Gross investment	142,911,000
	Net salvage value of land	283,000
C.	Net investment	142,628,000
	ANNUAL CHARGES	
a.	Interest (3-1/8%) on gross investment	4,466,000
b.	Amortization on net investment (50-year)	1,218,000
c.	Operation and maintenance	520,000
d.	Allowance for major replacements	42,000
e.	Adjustment for net loss of productivity of land (addition)	9,000
f.	Maintenance of navigation aids	4,000
g.	O. & M. - Bridges	25,000
	TOTAL ANNUAL CHARGES	6,284,000

Table 23

Initial cost and annual charges
Waterway on Chickasawhay River-Okatibbee Creek to Meridian
(1965 price level)

Item No.	Description	Cost
	INITIAL COST	
01	Lands and damages-------------------------------	$ 1,152,000
02	Relocations-------------------------------------	40,580,000
03	Reservoirs (clearing)---------------------------	4,320,000
04 & 05	Dams and locks----------------------------------	141,181,000
09	Channels and canals-----------------------------	4,062,000
19	Buildings, grounds and utilities----------------	344,000
20	Permanent operating equipment-------------------	546,000
	Contingencies (20%)-----------------------------	38,437,000
30	Engineering and design--------------------------	11,531,000
31	Supervision and administration------------------	16,144,000
	Subtotal----------------------------------	258,297,000
	Aids to navigation------------------------------	60,000
	GRAND TOTAL	258,357,000
A.	Project net cost--------------------------------	258,357,000
	Interest during construction--------------------	32,296,000
B.	Gross investment--------------------------------	290,653,000
	Net salvage value of land-----------------------	864,000
C.	Net investment----------------------------------	289,789,000
	ANNUAL CHARGES	
a.	Interest (3-1/8%) on gross investment---------	9,083,000
b.	Amortization on net investment (50-year)------	2,475,000
c.	Operation and maintenance----------------------	780,000
d.	Allowance for major replacements---------------	62,000
e.	Adjustment for net loss of productivity of land (addition)	34,000
f.	Maintenance of navigation aids-----------------	15,000
g.	O. & M. - Bridges------------------------------	75,000
	TOTAL ANNUAL CHARGES--------------------	12,524,000

Table 24

Waterway plans A, B, and C
Summary of first costs and annual charges
(1965 price level)

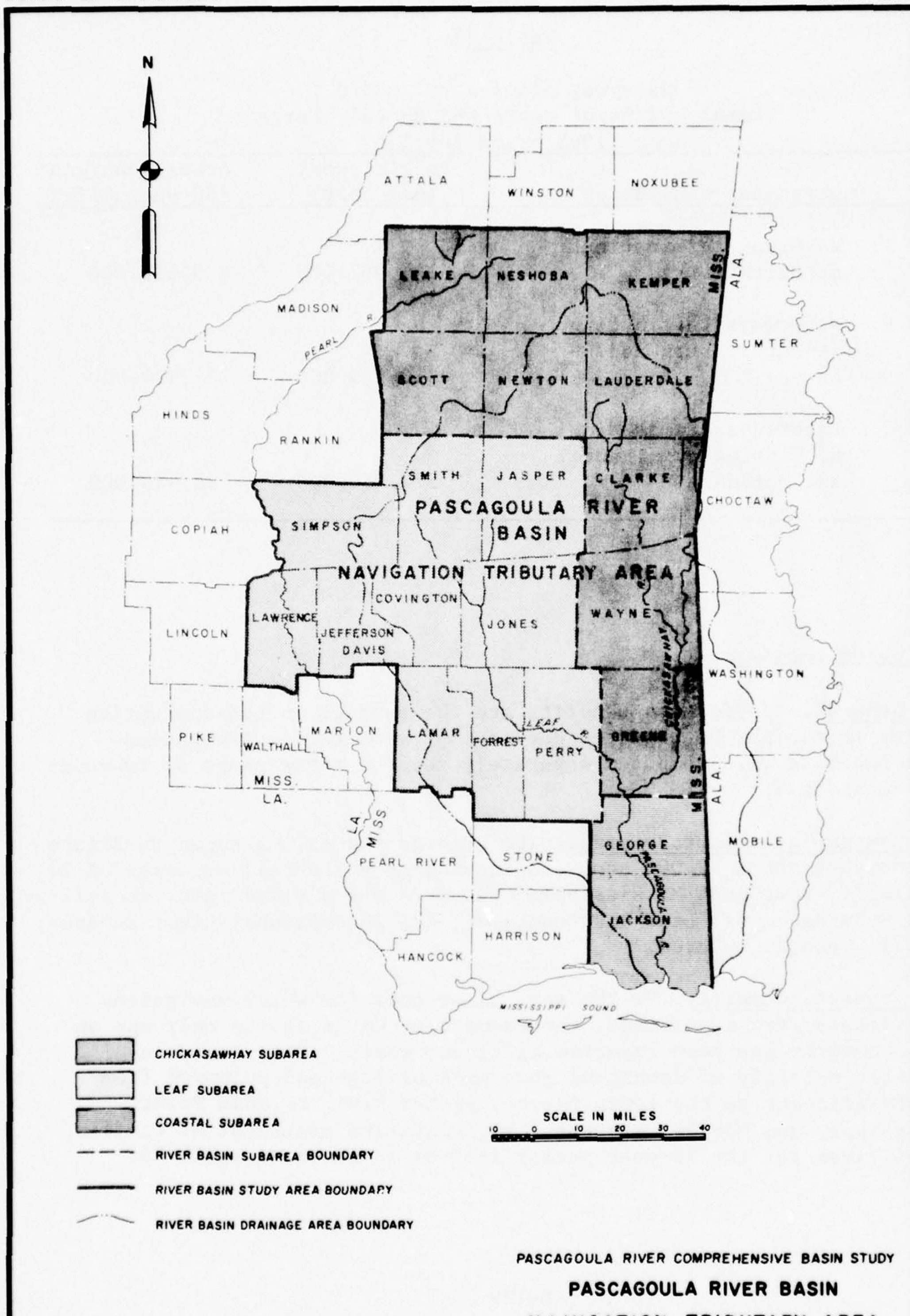
Improvement considered	Initial cost (net cost)	Annual charges (50-year life)
Plan A: Waterway terminating at Hattiesburg	$184,067,000	$ 9,620,000
Plan B: Waterways terminating at Hattiesburg and Laurel	316,623,000	15,904,000
Plan C: Waterways terminating at Hattiesburg, Laurel and Meridian	574,980,000	28,428,000

NAVIGATION ECONOMICS

General. Navigation benefits are the savings in transportation charges that might be expected due to improvements for navigation. These benefits were computed separately for the three plans of improvement considered.

Navigation tributary area. The tributary area, as shown on Figure 24, embraces about 12,000 square miles and comprises all or parts of 21 counties in southeast Mississippi. The area was divided into the following 3 subareas: (1) Leaf River subarea; (2) Chickasawhay River subarea; and (3) Coastal subarea.

Present commerce. Of the several streams for which navigation improvements were considered, the Pascagoula River is the only one on which commerce has been reported in recent years. This commerce consisted entirely of downbound movements of logs and pulpwood from forests adjacent to the lower reaches of the river to Moss Point, Mississippi, and Mobile, Alabama. A comparative statement of traffic on the river for the 10-year period 1955-64 is shown in Table 25.



PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

PASCAGOULA RIVER BASIN

NAVIGATION TRIBUTARY AREA

Table 25

Comparative statement of traffic
Pascagoula River (1955-1964)

Year	Commodity	Tons
1955	Logs	18,000
1956	Logs	10,900
1957	Logs	10,200
1958	Logs	400
1959	Logs	7,000
1960	Logs and pulpwood	6,400
1961	Logs and pulpwood	1,900
1962	No commerce reported	-
1963	No commerce reported	-
1964	No commerce reported	-

Traffic surveys and studies. To determine commerce that would be available for movement over the considered waterways, a traffic survey was made in 1965 of all principal firms in the 21-county tributary area receiving or shipping significant tonnages of freight. Data obtained included the nature of commodities handled, tonnages shipped or received annually, points of origin or destination of commodity movements reported, mode of transportation now employed, estimated future expansion which might affect volume of shipments and receipts, and other related information. About 125 firms were contacted during the survey.

In addition to the traffic canvass, studies were made of tributary area requirements for commodities, such as petroleum products, which could be estimated on a per-capita basis. The data developed were used to estimate inbound tonnages which might be available for movement over the considered waterway. A study of mineral resources presented in a report dated September 1965, entitled "MINERAL SUPPLY STUDY, PASCAGOULA RIVER BASIN NAVIGATION AREA, MISSISSIPPI," prepared by the Bureau of Mines, U. S. Department of the Interior, was considered in the determination of prospective commerce of minerals and mineral products available for waterway movement. The total traffic developed by canvass and study amounted to 2,908,000 tons, of which 1,617,000 tons were inbound and 1,291,000 tons outbound. This traffic is shown by commodity groups in Table 26.

Table 26

Potential waterway commerce for tributary area
(Determined by traffic survey and requirement studies in 1965)

Commodity or commodity group	Tonnage		
	Inbound	Outbound	Total
Animal and animal products, inedible	7,400	2,400	9,800
Vegetable food products and beverages	211,700	25,200	236,900
Vegetable products, inedible	14,100	61,700	75,800
Wood and paper	332,000	617,000	949,000
Non-metallic minerals	879,800	564,900	1,444,700
Metals and manufactures	51,900	13,900	65,800
Chemicals and related products	119,600	5,900	125,500
Total (rounded)	1,617,000	1,291,000	2,908,000

Commerce subjected to transportation rate analysis. The commodities comprising the potential commerce were analyzed and all items were eliminated which obviously would not move over the water, because of the nature of the particular commodity, the circuity of routing, or other reasons. The remaining traffic amounted to 2,470,000 tons, of which 1,332,000 tons were inbound and 1,138,000 tons outbound. This traffic, shown in Table 27 by commodity groups, was analyzed with respect to present and prospective transportation charges.

Transportation rate analyses. The rate analyses consisted of comparisons of estimated rates over the considered waterway with the lowest rates available for other routes or modes of transportation. The modes of transportation compared for this study included rail, truck, pipeline, and alternative waterways, or combinations thereof.

In determining the lowest available rates, published rates were used where applicable. Where published rates were not available, rates were constructed. In either case, consideration was given to the relatively large unit shipments involved in barge transportation, when compared with overland transportation, and to other differences in services provided which have a direct bearing on transportation rates.

Table 27

Traffic subjected to rate analysis

Commodity and commodity group	Tonnage Inbound	Outbound	Total
Animals and animal products, inedible	1,500	1,000	2,500
Vegetable food products	150,800	0	150,800
Vegetable products, inedible	13,700	61,700	75,400
Wood and paper	315,600	513,900	829,500
Non-metallic minerals	769,800	551,000	1,320,800
Metals and manufactures	11,800	4,600	16,400
Chemicals and related products	69,000	5,900	74,900
Total (rounded)	1,332,000	1,138,000	2,470,000

Prospective barge rates applied to commodity movements on the considered waterway were developed from operating data and related information obtained from carriers, shippers, and other sources concerned with inland waterway transportation. Handling and transfer charges were developed from information obtained from published rates or from information furnished by carriers, shippers, and terminal operators.

PROSPECTIVE WATERWAY TONNAGES AND SAVINGS

General. The principal commodities of prospective inbound commerce include petroleum products, petrochemicals, corn, and cement. Principal outbound commerce includes sand and gravel, wallboard, and naval stores.

Petroleum products. The requirements for gasoline and other motor fuels in the tributary area were determined from statistics on total state comsumption furnished by the Mississippi State Tax Commission. Consumption by counties was estimated by proration according to motor vehicle registration. On this basis, the 1965 requirement for motor fuels in the 21-county tributary area was estimated at 621,000 tons.

Refined products are shipped into the tributary area by rail, truck, and pipeline. Two pipelines originating near Houston, Texas

traverse the tributary area and distribute refined products through outlets at Collins, Lockhart, and Meridian. About 1,094,000 tons of gasoline, kerosene, and other distillate fuels were delivered to these outlets in 1964 for distribution in the tributary area and adjacent territory.

Grain. Grain is shipped from the midwest into the tributary area to supply the requirements for livestock feeds. It is estimated that present inbound shipments amount to about 121,000 tons annually. Considerable quantities of this grain are shipped into the area by joint barge-rail or barge-truck movements through the port of Vicksburg, Mississippi.

Sand and gravel. The major producing deposits of sand and gravel in the tributary area are located near or immediately adjacent to the Leaf River in the vicinity of Hattiesburg. Forrest County, in which Hattiesburg is located, leads the State in production of sand and gravel. The principal markets for these commodities are the larger industrial centers including New Orleans, Meridian, Pascagoula, and Mobile, all within a radius of 115 miles of Hattiesburg. Most of the shipments move by rail.

The estimated prospective waterway tonnages and savings, by commodities, based on the 1965 survey, are shown in Table 28.

Prospective water commerce and savings over life of project. Economic changes, both locally within the tributary area and nationally, are expected to be reflected in corresponding increases or decreases in the annual volume of commerce available for movement over the considered waterways. Economic indicators considered applicable in determining future waterway tonnages of the prospective commerce are shown in Table 29, and the corresponding change factors applicable thereto are shown in Table 30.

Table 28

Prospective waterway tonnages and savings based on present commerce

Commodity	Plan A Tons	Plan A Savings	Plan B Tons	Plan B Savings	Plan C Tons	Plan C Savings
INBOUND:						
Vegetable food products:						
Corn, bulk	25,000	$31,300	96,000	$122,900	98,800	$124,400
Flour, bulk	3,100	2,800	3,100	2,800	3,100	2,800
Sugar, bagged	1,000	400	1,000	400	1,000	400
Subtotal (rounded)	29,000	34,000	100,000	126,000	103,000	128,000
Vegetable products, inedible:						
Soybean meal	-	-	3,000	7,000	3,000	7,700
Molasses, blackstrap	2,000	2,300	2,000	2,300	3,500	3,100
Subtotal (rounded)	2,000	2,000	5,000	10,000	6,000	11,000
Wood and paper:						
Paper and paper products	900	500	900	500	900	500
Subtotal (rounded)	1,000	1,000	1,000	1,000	1,000	1,000
Nonmetallic minerals:						
Petroleum products, refined	83,700	102,300	161,400	192,400	208,800	261,000
Liquid petroleum gas	900	700	9,800	19,600	33,800	58,600
Residual fuel oil	-	-	6,000	13,100	6,000	13,100
Isobutylene	66,400	10,000	66,400	10,000	66,400	10,000
Normal butylene	25,800	5,500	25,800	5,500	25,800	5,500
Cement, bulk	16,200	2,100	16,200	2,100	16,200	2,100
Salt, bulk	5,000	4,600	5,000	4,600	6,900	7,000
Natural gasoline	48,400	11,100	48,400	11,100	48,400	11,100
Subtotal (rounded)	246,000	136,000	339,000	258,000	412,000	368,000
Chemicals & related products:						
Ammonium nitrate	-	-	1,000	2,400	1,000	2,400
Sulphuric acid	11,000	15,000	11,000	15,000	24,000	33,200
Creosote preservative	-	-	-	-	2,600	3,600
Phosphate rock	-	-	-	-	12,500	16,200
Superphosphate	-	-	-	-	1,000	900
Subtotal (rounded)	11,000	15,000	12,000	17,000	41,000	56,000
TOTAL INBOUND	289,000	188,000	457,000	412,000	563,000	564,000
OUTBOUND						
Vegetable products, inedible						
Naval stores (Rosin soap)	13,500	1,700	13,500	1,700	13,500	1,700
Subtotal (rounded)	14,000	2,000	14,000	2,000	14,000	2,000
Wood and paper						
Wallboard	-	-	25,700	32,500	25,700	32,500
Subtotal (rounded)	-	-	26,000	32,000	26,000	32,000
Nonmetallic minerals						
Brick	1,500	200	1,500	200	1,500	200
Sand and gravel	500,000	251,000	500,000	251,000	500,000	251,000
Concrete products	10,000	14,900	10,000	14,900	10,000	14,900
Subtotal (rounded)	512,000	266,000	512,000	266,000	512,000	266,000
TOTAL OUTBOUND	526,000	268,000	552,000	300,000	552,000	300,000
LOCAL						
Nonmetallic minerals						
Sand and gravel	-	-	56,000	14,600	166,000	61,900
TOTAL LOCAL (rounded)	-	-	56,000	15,000	166,000	62,000
GRAND TOTAL	815,000	456,000	1,065,000	727,000	1,281,000	926,000

Table 29

Economic indicators used in projecting waterway commerce

Commodity	Projection indicator reference[1]	Commodity	Projection indicator reference[1]
LEAF RIVER SUBAREA		CHICKASAWHAY RIVER SUBAREA	
Inbound:		Inbound:	
Grain & grain prods.	A	Grain & grain prods.	G
Molasses, blackstrap	A	Molasses, blackstrap	G
Salt, bulk	A	Phosphate rock	H
Ammonium nitrates, bagged	B	Sulphuric acid	H
Sulphuric acid	B	Superphosphate	H
Cement	C	Creosote preservative	I
Sand and gravel	C	Sand and gravel	I
Liquefied petroleum gases	D	Liquefied petroleum gases	J
Petroleum prods., ref.	D	Petroleum prods., ref.	J
Sugar, bagged	D	Salt, bagged	J
Paper & paper products	E		
Isobutylene	F		
Natural gasoline	F		
Normal butylene	F		
Outbound:			
Naval stores	K		
Brick	L		
Concrete products	L		
Sand and gravel	L		
Wallboard	L		

[1] Explanation of indicator references:

A Value of livestock production in counties of Leaf River subarea.
B Value of crop production in counties of Leaf River subarea.
C Wage and salary income from contract construction in Leaf River subarea.
D Population in Leaf River subarea.
E Value added by manufacture, paper and allied products, Leaf River subarea.
F Value added by manufacture, chemicals and allied products, Leaf River subarea.
G Value of livestock production in Chickasawhay River subarea.
H Value of crop production in Chickasawhay River subarea.
I Wage and salary income from contract construction in Chickasawhay River subarea.
J Population in Chickasawhay River subarea.
K National manufacturing index of chemical production.
L National value of new construction.

Table 30

Factors used in projecting waterway tonnages and savings over life of project

Indicator reference	Ratio to 1965			
	1965	1980	2015	2030
Leaf River subarea				
A	1.00	1.88	2.97	3.16
B	1.00	0.99	1.26	1.48
C	1.00	1.68	5.54	8.75
D	1.00	1.12	1.90	3.06
E	1.00	1.75	5.58	7.49
F	1.00	1.64	3.99	5.14
Chickasawhay River subarea				
G	1.00	1.47	2.51	2.93
H	1.00	0.95	1.09	1.23
I	1.00	1.63	4.24	6.05
J	1.00	1.08	1.64	2.48
National scope				
K	1.00	1.88	6.99	12.03
L	1.00	1.99	6.89	9.89

The projection factors shown in Table 30 were applied to the tonnages and savings of the respective commodities shown in Table 28 to derive the projected waterway tonnages and savings for selected years over the life of the project. The projected tonnages are shown in Table 31.

Current (1965) and projected waterway tonnages and savings for the three plans of improvement considered are summarized in Table 32. Average annual equivalent savings have been computed on the basis of a 3-1/8 percent discount rate for a project economic life of both 50 and 100 years, assuming project completion in 1980.

Table 31

Projected waterway tonnages and savings by commodity groups for years 1980, 2015, and 2030

Commodity	1965 Tons	1965 Savings	1980 Tons	1980 Savings	2015 Tons	2015 Savings	2030 Tons	2030 Savings
				PLAN "A"				
INBOUND								
Vegetable food products	29,000	$ 34,000	54,000	$ 64,000	85,000	$ 102,000	92,000	$ 109,000
Vegetable products, inedible	2,000	2,000	4,000	4,000	6,000	7,000	6,000	7,000
Wood and paper	1,000	1,000	2,000	1,000	5,000	3,000	7,000	4,000
Nonmetallic minerals	246,000	136,000	374,000	174,000	826,000	327,000	1,139,000	485,000
Chemicals and related products	11,000	15,000	11,000	15,000	14,000	19,000	16,000	22,000
Total inbound	289,000	188,000	445,000	258,000	936,000	458,000	1,260,000	627,000
OUTBOUND								
Vegetable products, inedible	14,000	2,000	25,000	3,000	94,000	12,000	162,000	20,000
Wood and paper	-	-	-	-	-	-	-	-
Nonmetallic minerals	512,000	266,000	1,018,000	530,000	3,524,000	1,834,000	5,059,000	2,632,000
Total outbound	526,000	268,000	1,043,000	533,000	3,618,000	1,846,000	5,221,000	2,652,000
GRAND TOTAL, PLAN "A"	815,000	456,000	1,488,000	791,000	4,554,000	2,304,000	6,481,000	3,279,000
				PLAN "B"				
INBOUND								
Vegetable food products	100,000	$ 126,000	187,000	$ 237,000	296,000	$ 374,000	316,000	$ 398,000
Vegetable products, inedible	5,000	10,000	9,000	19,000	15,000	30,000	16,000	32,000
Wood and paper	1,000	1,000	2,000	1,000	5,000	3,000	7,000	4,000
1/ Nonmetallic minerals	395,000	273,000	565,000	344,000	1,342,000	705,000	1,954,000	1,076,000
Chemicals and related products	12,000	17,000	12,000	17,000	15,000	22,000	18,000	26,000
Total inbound	513,000	427,000	775,000	618,000	1,673,000	1,134,000	2,311,000	1,536,000
OUTBOUND								
Vegetable products, inedible	14,000	2,000	25,000	3,000	94,000	12,000	162,000	20,000
Wood and paper	26,000	32,000	51,000	65,000	177,000	224,000	254,000	321,000
Nonmetallic minerals	512,000	266,000	1,018,000	530,000	3,524,000	1,834,000	5,059,000	2,632,000
Total outbound	552,000	300,000	1,094,000	598,000	3,795,000	2,070,000	5,475,000	2,973,000
GRAND TOTAL, PLAN "B"	1,065,000	727,000	1,869,000	1,216,000	5,468,000	3,204,000	7,786,000	4,509,000
				PLAN "C"				
INBOUND								
Vegetable food products	103,000	$ 128,000	192,000	$ 239,000	303,000	$ 378,000	324,000	$ 403,000
Vegetable products, inedible	6,000	11,000	12,000	20,000	19,000	32,000	20,000	34,000
Wood and paper	1,000	1,000	2,000	1,000	5,000	3,000	7,000	4,000
1/ Nonmetallic minerals	578,000	430,000	818,000	528,000	1,929,000	1,086,000	2,801,000	1,635,000
Chemicals and related products	41,000	56,000	41,000	57,000	55,000	76,000	66,000	91,000
Total inbound	729,000	626,000	1,065,000	845,000	2,311,000	1,575,000	3,218,000	2,167,000
OUTBOUND								
Vegetable products, inedible	14,000	2,000	25,000	3,000	94,000	12,000	163,000	20,000
Wood and paper	26,000	32,000	51,000	65,000	177,000	224,000	254,000	321,000
Nonmetallic minerals	512,000	266,000	1,018,000	530,000	3,524,000	1,834,000	5,059,000	2,632,000
Total outbound	552,000	300,000	1,094,000	598,000	3,795,000	2,070,000	5,476,000	2,973,000
GRAND TOTAL, PLAN "C"	1,281,000	926,000	2,159,000	1,443,000	6,106,000	3,645,000	8,694,000	5,140,000

1/ Includes local movement of sand and gravel.

Table 32

Summary of current and projected waterway tonnages and savings

Year	PLAN A Tons (1,000)	PLAN A Savings ($1,000)	PLAN B Tons (1,000)	PLAN B Savings ($1,000)	PLAN C Tons (1,000)	PLAN C Savings ($1,000)
Current (1965)	815	456	1,065	727	1,281	926
1980	1,488	791	1,869	1,216	2,159	1,443
2015	4,554	2,304	5,468	3,204	6,106	3,645
2030[1]	6,481	3,279	7,786	4,509	8,694	5,140
Average annual equiv. savings:						
50-year project life		1,652		2,350		2,703
100-year project life		1,940		2,732		3,134

[1] Tonnages and savings are assumed to remain constant after 2030

RESULTS OF THE INVESTIGATION

Comparison of benefits and costs. Table 33 shows benefits, costs, and the benefit-to-cost ratios for the three plans of improvement considered, based on a project life of 50 years.

Table 33

Waterway plans A, B, and C
Comparison of benefits and costs[1]

Improvement considered	Average annual equivalent benefits	Average annual charges	Benefit-to-cost ratio
PLAN A			
Waterway terminating at Hattiesburg	$1,652,000	$ 9,620,000	0.17
PLAN B			
Waterways terminating at Hattiesburg and Laurel	2,350,000	15,904,000	0.15
PLAN C			
Waterways terminating at Hattiesburg. Laurel and Meridian	2,703,000	28,428,000	0.10

[1] Based on a project life of 50 years.

Conclusions. As shown above, Plan A offers a slightly larger percentage return in benefits than Plans B or C. The benefit-to-cost ratios, all less than 0.20, indicate that development of all or part of the waterway system for navigation is not warranted at this time. Further, since the cities of Hattiesburg, Laurel and Meridian are presently the only terminals which would reasonably be expected to generate significant volumes of traffic, development of a lesser scope such as channel improvements as far as Merrill offers an even less feasible possibility.

PART B — HYDROELECTRIC POWER STUDIES

GENERAL

The need exists for the continued development of power in the Pascagoula River Basin area. This area is served by the Mississippi Power Company which is a part of the Southern Company with interconnections to the Alabama Power Company. There are no hydroelectric plants in the basin.

The possibilities of providing hydroelectric power capacity at prospective damsites in the basin were investigated. At all of these sites, the head and runoff were sufficient only for the installation of small capacity plants. The wide valleys and poor foundation conditions resulted in high costs for the dams and power plant structures. However, the sites afford opportunities for future development to meet the growing power needs of the area.

LOCATION OF SITES

Preliminary design, cost and economic studies were made of thirty-six possible reservoir sites in the basin to determine economic feasibility and to select the more favorable sites for detailed investigation. During these studies, all but five of the sites were eliminated for power purposes due to the factors mentioned in the previous paragraph. Data on these remaining five sites were developed in greater detail and are presented herein. The locations and drainage areas of the sites are given in Table 34.

STREAM FLOW

The mean monthly stream flows used in the power computations for the Escatawpa River sites were based on those recorded at the Escatawpa River gage near Wilmer, Alabama, drainage area of 506 square miles,

Table 34

Locations and drainage areas of sites investigated for power

Site No.	Name	Stream	Location	Drainage area sq. mi.
1	Harleston	Escatawpa R.	George-Jackson County line, Miss.	583
2	Upper Escatawpa	Escatawpa R.	In N.W. corner of Mobile County, Ala.	425
24	Bucatunna	Bucatunna Cr.	Near Bucatunna, Miss.	495
27	Waynesboro	Chickasawhay R.	Near Waynesboro,Miss.	1,640
9	Benndale	Black Creek	In N.E. corner of Stone County, Miss.	530

for the period September 1945 through September 1963. The flows for the Bucatunna and Waynesboro sites were based on those recorded at nearby gages for the periods January 1939 through September 1949 and October 1938 through September 1950, respectively, and computed for these gages for the remaining periods through September 1963 by correlations with the Enterprise gage on the Chickasawhay River, drainage area of 913 square miles. The flows used for the Benndale site were based on a correlation of the continuous flows recorded from October 1952 through September 1963, at the Biloxi River gage at Wortham, Mississippi. This gage is located in an adjoining area of similar runoff characteristics. Tabulations of the mean monthly flows in c.f.s. per square mile are shown in Tables 35 through 38.

EVAPORATION

Evaporation losses at each considered power project in the Pascagoula River Basin were computed using a factor of 0.004 c.f.s. per acre at average pool level.

CAPACITY

The dependable capacity and installed capacity for the considered projects in the Pascagoula River Basin were determined from storage-draft curves constructed for the applicable area and from tailwater curves and storage-area curves for each project. The storage-area, tailwater and storage-draft curves for the considered power projects are shown on Figures 25 through 27, respectively. Pertinent data used in the capacity computations and the resulting capacities are summarized in Table 39.

Table 35

Mean monthly flows in second feet per square mile 1/
Escatawpa River near Wilmer, Alabama
(Drainage area 506 square miles)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1945									.30	.50	.83	2.26	0.97
1946	4.64	3.74	5.36	1.56	4.99	3.21	3.17	2.52	2.14	.53	.94	.70	2.81
1947	4.76	1.44	5.87	7.69	2.65	1.29	.36	.63	1.06	.39	4.29	5.90	3.03
1948	2.44	2.91	7.42	2.16	.92	.53	.72	1.49	1.33	.54	9.49	4.59	2.88
1949	2.45	3.54	4.63	2.70	2.69	2.06	3.12	1.90	2.07	.80	.56	1.31	2.32
1950	1.32	1.16	3.25	1.77	.94	.47	3.18	1.49	2.27	.47	.36	1.53	1.52
1951	1.36	2.14	5.40	4.18	.48	1.26	.52	.28	.48	.22	.45	.67	1.45
1952	.56	1.77	1.77	2.01	1.62	.36	.27	.27	.29	.13	.20	1.15	0.87
1953	2.09	4.20	2.66	3.36	1.44	.32	1.11	1.67	.43	.18	.60	5.11	1.93
1954	1.16	1.00	1.30	1.55	.30	.23	.29	.10	.11	.14	.22	.35	0.56
1955	1.87	2.24	.41	7.42	1.07	.45	1.42	2.64	.40	.37	.35	.81	1.62
1956	.73	1.86	3.87	.76	.52	1.08	4.15	.45	.58	1.00	.37	3.97	1.61
1957	1.23	1.36	1.37	3.65	1.94	1.17	.59	2.05	5.21	1.41	4.95	1.65	2.22
1958	3.08	2.24	3.26	1.85	1.67	1.83	4.27	1.60	2.46	.71	.49	.56	2.00
1959	1.20	4.01	2.96	2.81	2.02	8.80	1.64	1.52	1.95	3.23	1.47	1.29	2.74
1960	2.23	3.33	2.94	3.81	3.51	.37	.86	.84	1.37	.67	.57	.63	1.76
1961	1.95	9.11	7.37	5.41	1.52	3.00	1.81	2.58	2.14	.95	3.19	9.55	4.05
1962	4.38	2.68	2.66	4.73	1.20	1.66	.57	.53	.39	.42	.42	.54	1.68
1963	1.96	2.08	1.41	.34	.31	.30	.54	.19	.22				0.82

1/ At U.S. Geological Survey gage. To obtain flows in second-feet at Harleston site multiply by 583 and at Upper Escatawpa site by 425.

Table 36

Mean monthly flows in second-feet per square mile 1/
Bucatunna Creek at Denham, Mississippi
(Drainage area 468 square miles)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1939	.99	3.26	4.49	1.45	.74	2.56	.82	.51	.27	.14	.12	.31	1.31
1940	.57	4.45	1.71	2.18	3.51	2.01	6.67	.69	.25	.16	.26	1.45	1.99
1941	1.05	1.18	3.04	1.87	.44	.14	.98	.27	.24	.07	.16	2.15	0.97
1942	1.89	1.84	5.02	1.52	.60	.37	.23	.27	.21	.20	.28	2.34	1.23
1943	2.33	1.91	5.85	2.21	.61	.27	.20	.16	.10	.06	.24	.40	1.20
1944	1.24	2.71	5.77	8.63	2.83	.66	.31	.73	.26	.12	.28	1.23	2.06
1945	2.15	3.35	3.57	2.99	2.10	.40	.36	.21	.09	.19	.25	1.10	1.40
1946	3.10	3.56	4.05	1.47	1.96	.77	1.03	3.40	.54	.20	.71	.83	1.80
1947	6.94	1.90	3.65	5.76	2.86	.97	.60	.20	.21	.10	.86	2.23	2.19
1948	1.54	3.65	8.17	2.95	.79	.28	.30	.27	.41	.43	3.27	4.47	2.21
1949	3.49	5.97	3.93	4.56	3.02	1.58	1.18	.62	2.10	.32 2/	.33	1.09	2.35
1950	6.20	5.48	3.60	1.01	2.89	.45	1.04	.76	1.25	.27	.58	2.20	2.14
1951	2.41	4.62	5.72	3.59	.52	.32	.18	.10	.11	.06	.13	1.19	1.58
1952	.86	1.20	1.91	1.22	.66	.21	.07	.11	.06	.02	.12	.29	0.56
1953	1.46	4.13	3.41	2.02	5.19	.26	.62	.18	.11	.05	.11	1.03	1.55
1954	1.53	1.11	1.70	2.01	1.00	.17	.23	.06	.04	.05	.08	.28	0.69
1955	.79	2.69	.73	2.79	.34	.21	.79	.56	.11	.07	.21	.52	0.82
1956	.38	6.23	6.95	4.16	.37	.27	.17	.12	.07	.07	.07	.54	1.62
1957	.68	1.08	1.28	2.81	.53	.32	.21	.07	.98	.97	3.90	1.67	1.21
1958	1.63	1.88	4.60	2.04	3.39	.81	2.51	.54	.70	.47	.43	.62	1.64
1959	2.02	2.72	1.67	1.81	.58	1.07	1.08	.53	.40	.65	1.21	1.25	1.25
1960	2.60	3.72	3.81	2.10	1.88	.28	.10	.52	.18	.33	.33	.47	1.36
1961	1.12	10.70	4.81	5.08	.47	1.72	2.60	.67	.24	.14	1.66	9.70	3.24
1962	7.63	2.99	1.77	5.08	.79	.29	.14	.14	.08	.18	.19	.29	1.63
1963	1.64	1.62	1.96	.44	.17	.18	.13	.17	.05				0.71

1/ At U.S. Geological Survey gage. To obtain flows in second-feet at Bucatunna site multiply by 495.
2/ Flows for Oct. 1949 - Sept. 1963 based on flow relation with Chickasawhay River gage at Enterprise.

Table 37

Mean monthly flows in second-feet per square mile 1/
Chickasawhay River at Waynesboro, Mississippi
(Drainage area 1,660 square miles)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1938										.11	.18	.34	0.21
1939	1.00	2.99	3.46	2.11	.80	2.06	.61	.30	.16	.13	.14	.34	1.18
1940	.54	3.72	1.27	2.31	2.60	.81	5.19	.48	.34	.20	.53	1.95	1.66
1941	1.12	1.31	2.20	1.57	.36	.21	1.47	.46	.24	.13	.24	1.75	0.92
1942	1.19	1.54	4.59	1.25	.63	.42	.23	.42	.38	.31	.31	1.45	1.06
1943	1.62	1.72	4.58	1.83	.52	.30	.27	.15	.17	.11	.31	.46	1.00
1944	1.12	2.58	4.27	6.45	3.51	.53	.50	1.19	.34	.22	.46	1.83	1.92
1945	2.26	4.07	3.90	2.71	1.92	.63	.51	.30	.16	.27	.26	.88	1.49
1946	2.99	4.49	4.15	1.09	2.35	1.10	1.31	2.04	.55	.26	.92	1.11	1.86
1947	6.69	1.50	3.16	4.76	2.16	1.15	.49	.24	.27	.16	.91	1.80	1.94
1948	1.40	4.01	6.45	2.82	.70	.31	.27	.31	.50	.42	2.95	4.70	2.07
1949	3.53	5.04	3.48	4.82	2.64	1.63	1.82	.85	1.03	.34	.35	.94	2.21
1950	3.73	4.01	2.66	.91	2.00	.39	.90	.60	.81	.29 2/	.57	1.87	1.56
1951	2.03	3.71	4.53	2.93	.51	.34	.22	.14	.15	.10	.17	1.05	1.32
1952	.79	1.06	1.63	1.09	.64	.24	.11	.15	.10	.06	.16	.32	0.53
1953	1.27	3.35	2.80	1.72	4.12	.28	.60	.22	.15	.09	.15	.94	1.31
1954	1.33	.99	1.45	1.71	.92	.21	.26	.10	.07	.09	.12	.31	0.63
1955	.74	2.25	.69	2.31	.36	.24	.74	.54	.15	.11	.24	.51	0.74
1956	.40	4.90	5.41	3.37	.39	.30	.21	.16	.11	.11	.11	.53	1.33
1957	.65	.98	1.13	2.33	.52	.34	.24	.11	.89	.88	3.20	1.44	1.06
1958	1.41	1.60	3.70	1.74	2.79	.75	2.11	.54	.67	.47	.44	.60	1.40
1959	1.72	2.29	1.44	1.56	.57	.96	.98	.52	.42	.63	1.07	1.10	1.10
1960	2.19	3.03	3.10	1.79	1.60	.31	.14	.51	.22	.35	.35	.47	1.17
1961	1.00	8.25	3.85	4.08	.47	1.49	2.19	.64	.27	.18	1.43	7.48	2.61
1962	6.00	2.49	1.52	4.10	.74	.32	.18	.18	.12	.22	.23	.32	1.37
1963	1.42	1.40	1.67	.45	.21	.22	.17	.21	.09				0.65

1/ At U.S. Geological Survey gage. To obtain flows in second-feet at Waynesboro site multiply by 1,640.

2/ Flows for Oct. 1950 - Sept. 1963 based on flow relation with Chickasawhay River gage at Enterprise.

Table 38

Mean monthly flows in second-feet per square mile 1/
Black Creek near Benndale, Mississippi
(Drainage area 760 square miles)

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1952										.25	.53	2.59	1.12
1953	2.25	5.59	2.50	3.12	1.05	1.77	1.55	1.74	2.20	.22	1.50	5.00	2.37
1954	1.64	1.15	1.39	1.25	.42	.36	1.42	.30	.25	.34	.48	1.30	0.86
1955	3.28	3.74	.76	7.23	1.07	.38	1.65	4.12	.52	.39	.50	.98	2.05
1956	1.06	2.14	2.46	1.00	.32	3.12	1.40	.70	2.39	1.75	.76	4.62	1.81
1957	1.31	1.12	1.81	2.39	1.59	.97	.42	.48	4.12	1.48	3.48	2.01	1.76
1958	3.57	2.06	4.72	2.11	4.08	2.34	4.30	1.95	2.27	.90	.59	.62	2.46
1959	1.51	4.85	2.58	2.72	2.69	5.88	3.73	1.94	2.73	3.53	1.57	1.35	2.92
1960	3.03	4.20	2.09	3.25	2.17	.32	1.36	2.81	2.32	.98	.74	.75	2.00
1961	2.48	8.80	8.20	3.40	1.38	3.13	2.14	1.74	4.85	.95	3.82	6.25	3.93
1962	3.73	2.27	2.08	1.59	.43	.80	.58	.69	.64	.29	.50	1.02	1.22
1963	2.04	2.48	1.38	.61	.70	.31	1.37	.84	.46				1.13

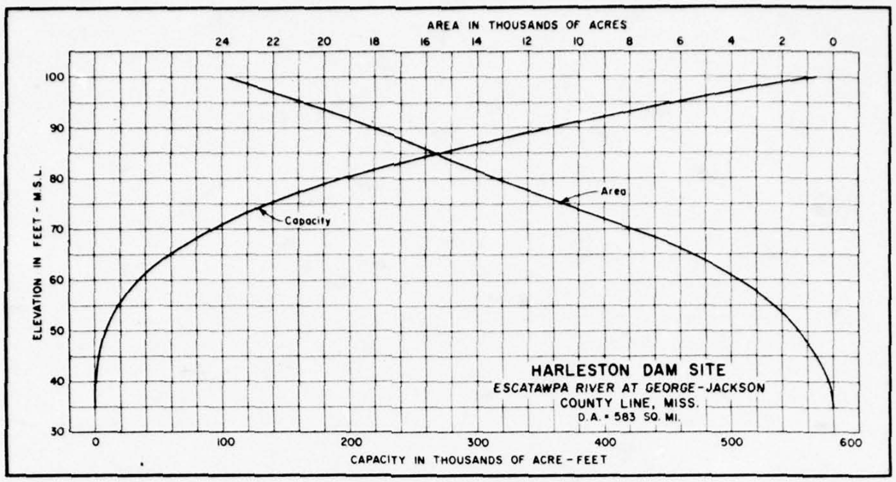
1/ At U.S. Geological Survey gage, based on flow relation with Biloxi River gage at Wortham. To obtain flows in second-feet at Benndale, multiply by 530.

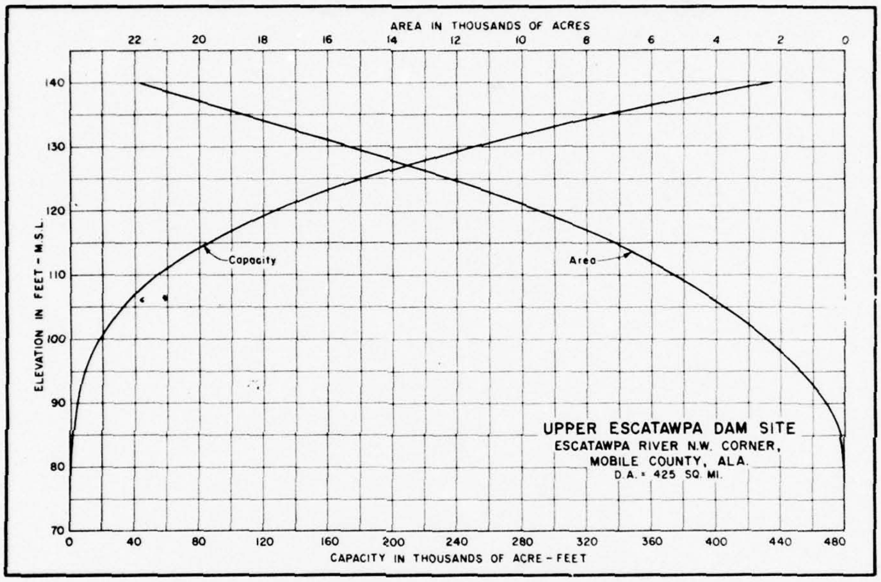
Table 39

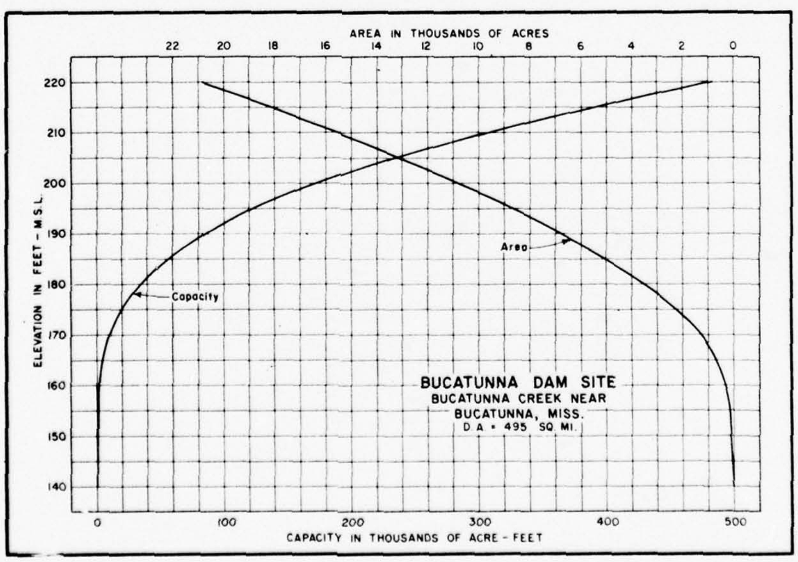
Pertinent data used in capacity determination

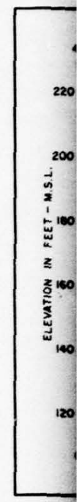
Item	Escatawpa River sites					
	Harleston No. 1	Upper Escatawpa No. 2	No. 1 with No. 2	Bucatunna No. 24	Waynesboro No. 27	Benndale No. 9
Maximum power pool elevation, m.s.l.	80	140	80	215	205	135
Drawdown, feet	7	10	6	10	10	10
Usable storage, acre-feet	80,000	184,000	71,000	156,000	227,000	153,000
Average evaporation and seepage, c.f.s.[1]	62	85	61	71	105	104
Net prime flow, c.f.s.	230	390	520	330	710	530
Average tailwater elevation, m.s.l.	46	88.5	48	152.5	144	73.5
Average net head (0.5 intake loss), feet	32	49	30.5	60	58.5	59
Dependable capacity (10% load factor), kw.	5,100	13,000	11,000	14,000	29,000	22,000
Installed capacity, kw.	5,100	13,000	11,000	14,000	29,000	22,000
Number of units	1	1	1	1	2	2
Type of turbines	Kaplan	Kaplan	Kaplan	Kaplan	Kaplan	Kaplan

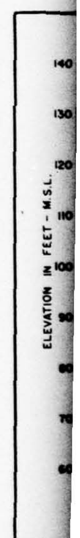
[1] 10 c.f.s. included for seepage.

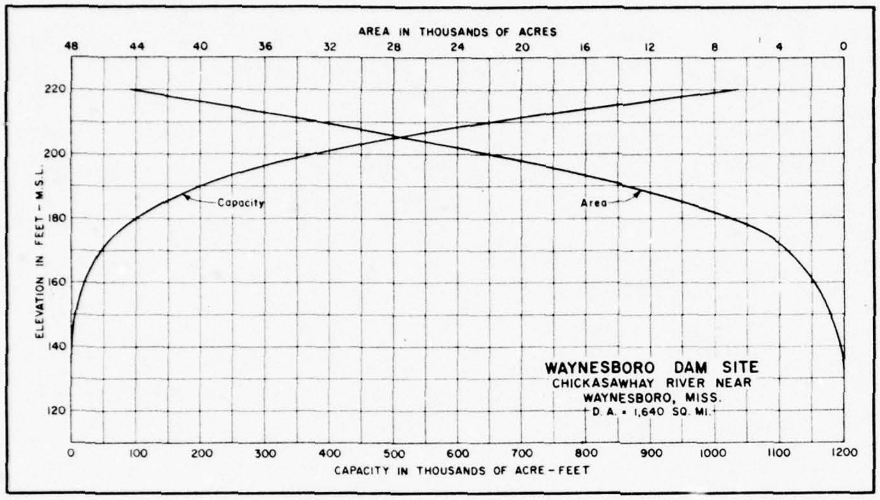

AREA IN THOUSANDS OF ACRES
ELEVATION IN FEET - M.S.L.
CAPACITY IN THOUSANDS OF ACRE-FEET
Capacity
Area
HARLESTON DAM SITE
ESCATAWPA RIVER AT GEORGE-JACKSON
COUNTY LINE, MISS.
D.A. = 583 SQ. MI.

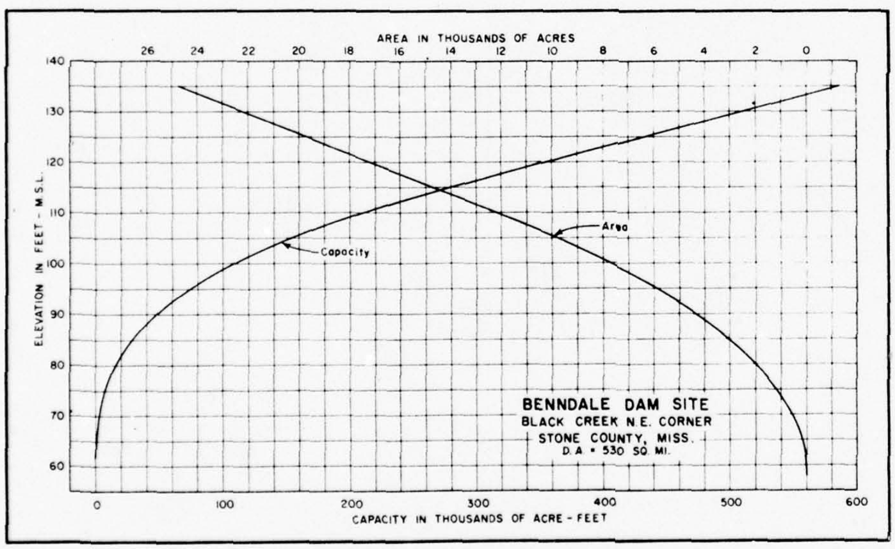

AREA IN THOUSANDS OF ACRES
ELEVATION IN FEET - M.S.L.
CAPACITY IN THOUSANDS OF ACRE-FEET
Capacity
Area
UPPER ESCATAWPA DAM SITE
ESCATAWPA RIVER N.W. CORNER,
MOBILE COUNTY, ALA.
D.A. = 425 SQ. MI.


AREA IN THOUSANDS OF ACRES
ELEVATION IN FEET - M.S.L.
CAPACITY IN THOUSANDS OF ACRE-FEET
Capacity
Area
BUCATUNNA DAM SITE
BUCATUNNA CREEK NEAR
BUCATUNNA, MISS.
D.A. = 495 SQ. MI.





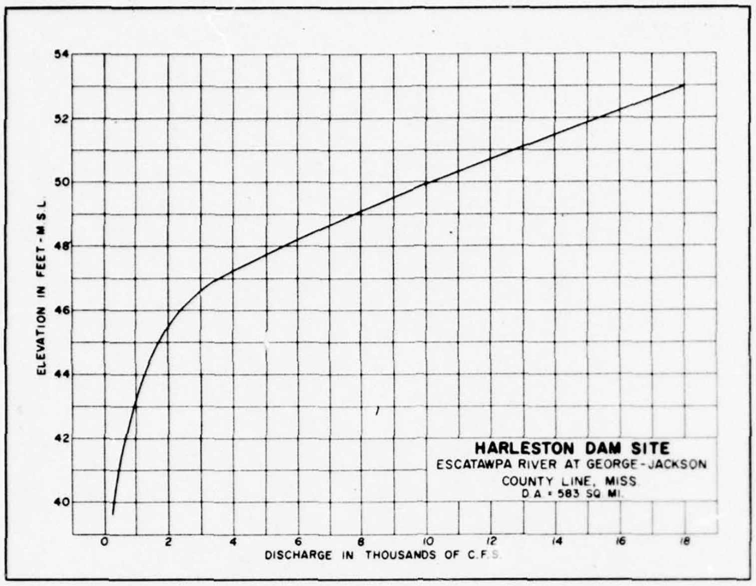


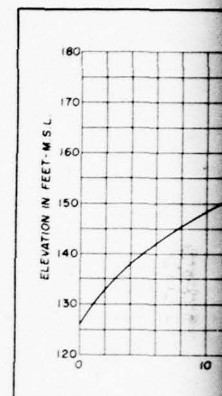


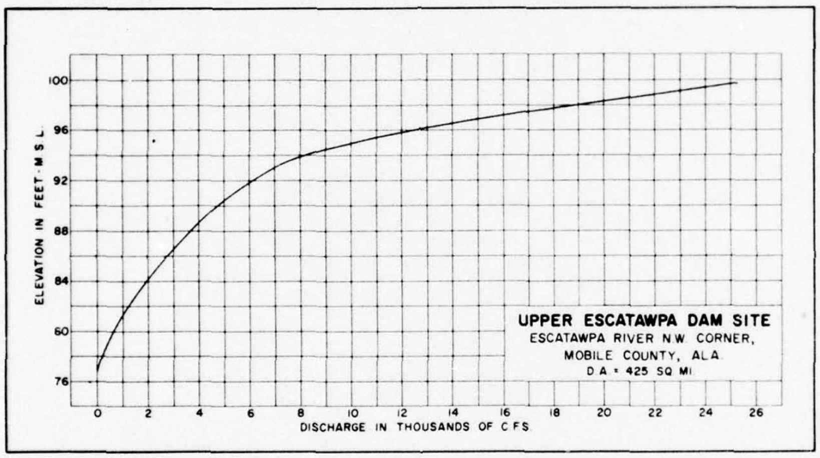
PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

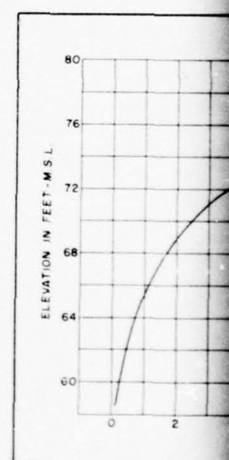
RESERVOIR STORAGE CAPACITY-AREA CURVES FOR CONSIDERED POWER PROJECTS

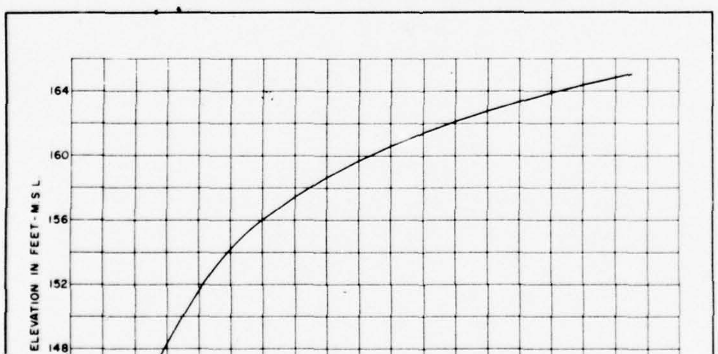
FIGURE 25


HARLESTON DAM SITE
ESCATAWPA RIVER AT GEORGE-JACKSON
COUNTY LINE, MISS.
D.A. = 583 SQ. MI.
ELEVATION IN FEET-M.S.L.
DISCHARGE IN THOUSANDS OF C.F.S.
54
52
50
48
46
44
42
40
0
2
4
6
8
10
12
14
16
18


ELEVATION IN FEET-M.S.L.
180
170
160
150
140
130
120
0
10

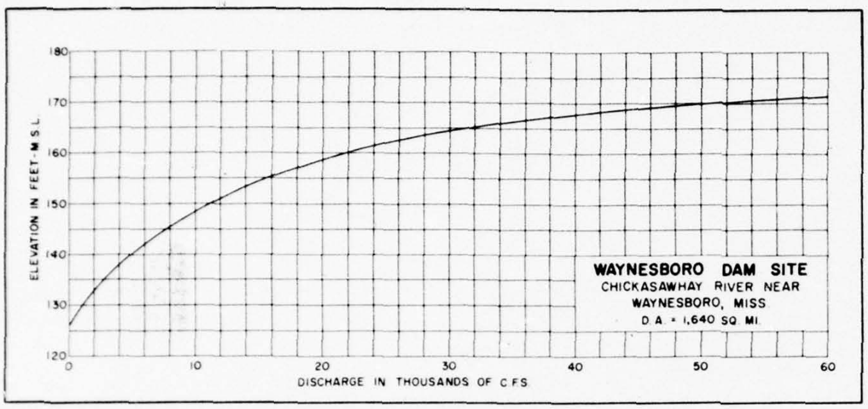

UPPER ESCATAWPA DAM SITE
ESCATAWPA RIVER N.W. CORNER,
MOBILE COUNTY, ALA.
D.A. = 425 SQ. MI.
ELEVATION IN FEET-M.S.L.
DISCHARGE IN THOUSANDS OF C.F.S.
100
96
92
88
84
80
76
0
2
4
6
8
10
12
14
16
18
20
22
24
26

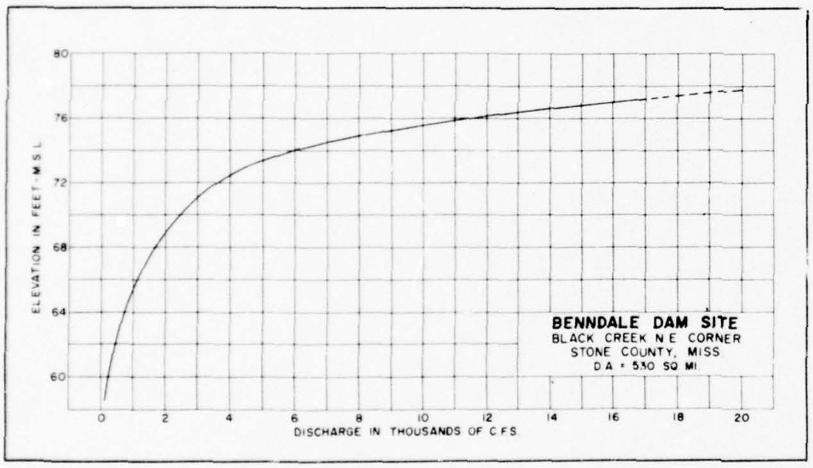

ELEVATION IN FEET-M.S.L.
80
76
72
68
64
60
0
2


BUCATUNNA DAM SITE
BUCATUNNA CREEK NEAR
BUCATUNNA, MISS.
D.A. = 495 SQ. MI.
ELEVATION IN FEET-M.S.L.
DISCHARGE IN THOUSANDS OF C.F.S.
164
160
156
152
148
144
140
0
2
4
6
8
10
12
14
16
18

2

E

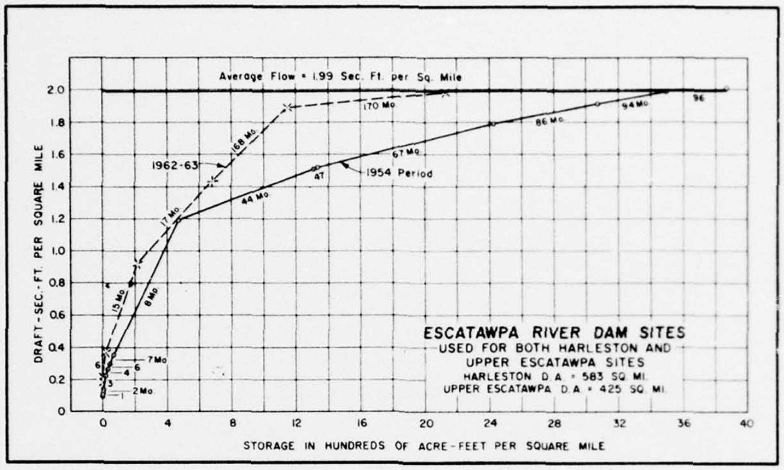


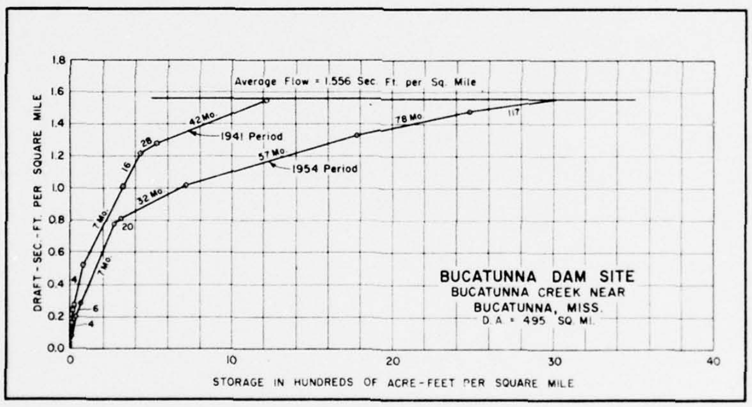


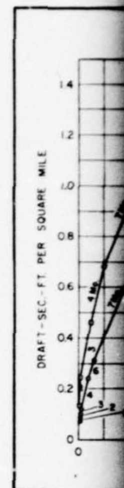
PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

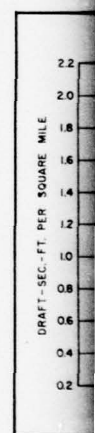
NATURAL TAILWATER CURVES FOR CONSIDERED POWER PROJECTS

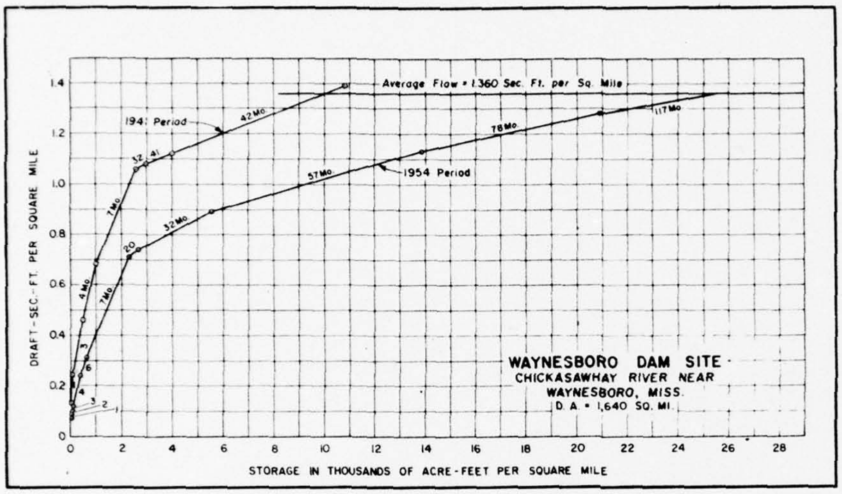
FIGURE 26

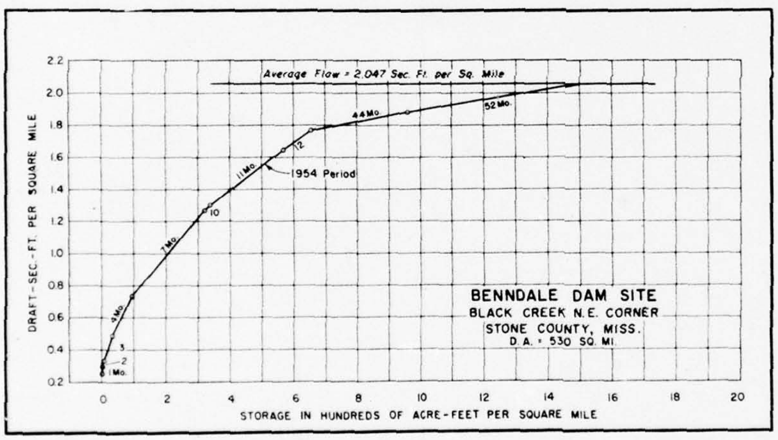

Average Flow = 1.99 Sec. Ft. per Sq. Mile
1962-63
1954 Period
ESCATAWPA RIVER DAM SITES
USED FOR BOTH HARLESTON AND
UPPER ESCATAWPA SITES
HARLESTON D.A. = 583 SQ. MI.
UPPER ESCATAWPA D.A. = 425 SQ. MI.
DRAFT-SEC.-FT. PER SQUARE MILE
STORAGE IN HUNDREDS OF ACRE-FEET PER SQUARE MILE


Average Flow = 1.556 Sec. Ft. per Sq. Mile
1941 Period
1954 Period
BUCATUNNA DAM SITE
BUCATUNNA CREEK NEAR
BUCATUNNA, MISS.
D.A. = 495 SQ. MI.
DRAFT-SEC.-FT. PER SQUARE MILE
STORAGE IN HUNDREDS OF ACRE-FEET PER SQUARE MILE


DRAFT-SEC.-FT. PER SQUARE MILE


DRAFT-SEC.-FT. PER SQUARE MILE





PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

STORAGE-DRAFT CURVES FOR CONSIDERED POWER PROJECTS

FIGURE 27

AVERAGE ANNUAL ENERGY

The energy output from stream regulation for the projects in the Pascagoula River Basin was determined from the duration-area curves constructed for each runoff area. The duration-area curves and the duration curves shown on Figure 28 were constructed using the unit flows given in Tables 35 through 38. The estimated energies that would be obtained are given in Table 40.

Table 40

Estimated energy from considered power projects

	Escatawpa River sites					
	Harleston No. 1	Upper Escatawpa No. 2	No. 1 with No. 2	Bucatunna No. 24	Waynesboro No. 27	Benndale No. 9
Average annual energy, million kwh.	20.2	24.0	22.1	26.6	76.0	37.7
Prime energy, million kwh.	4.4	11.4	9.5	11.9	25.0	18.8

POWER BENEFITS

The benefits from power were computed on the basis of current cost data in Power Supply Area 22 for alternative steam generation (furnished by the Federal Power Commission Regional Office for the Crooked Creek project in the Tallapoosa River Basin in a letter dated 10 January 1966.) The values for dependable capacity were estimated to be \$16.10 per kw. per year based on private financing and \$9.30 per kw. per year based on Federal financing. Energy value was estimated at 2.0 mills per kwh. The computed at-site power benefits from the projects in the Pascagoula River Basin using the values based on private financing are given in Table 41.

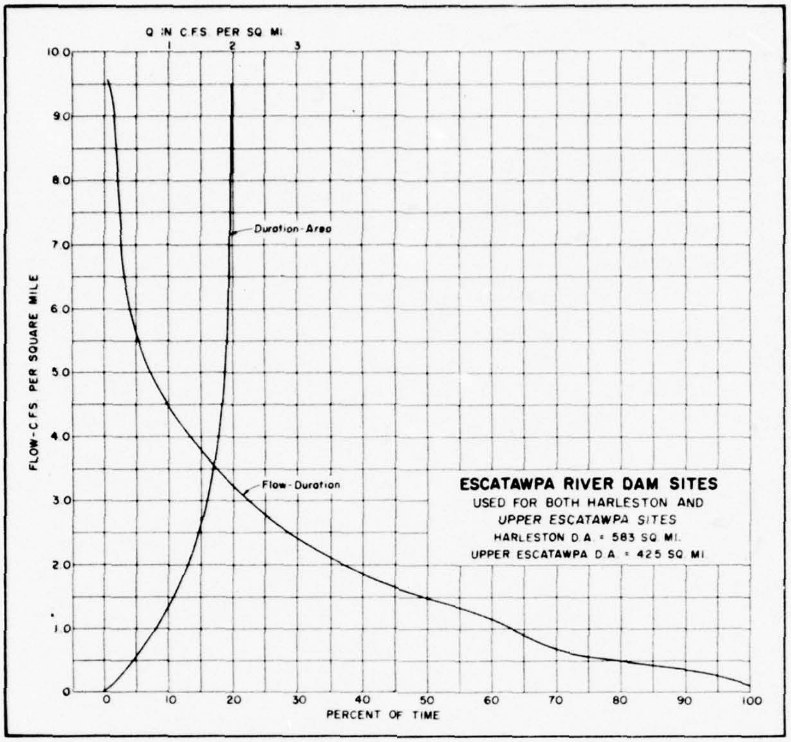
Table 41

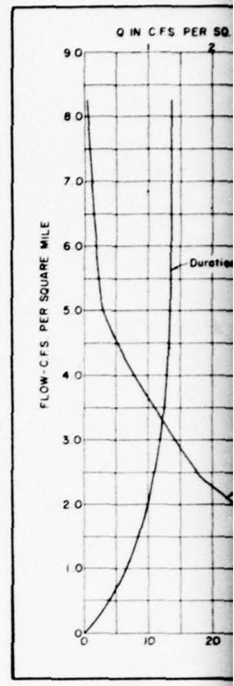
Estimated at-site power benefits for considered power projects

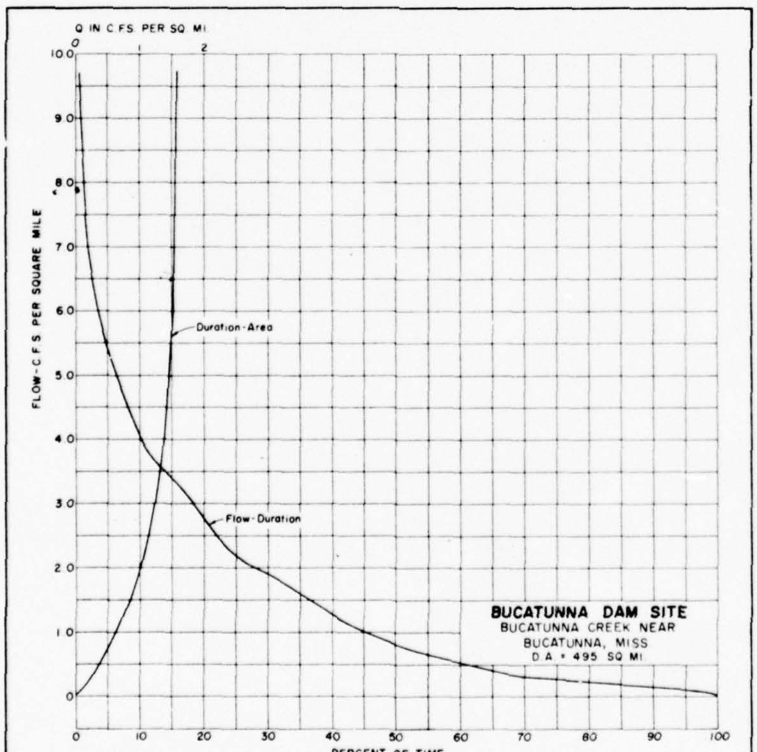
	Escatawpa River sites					
	Harleston No. 1	Upper Escatawpa No. 2	No. 1 with No. 2	Bucatunna No. 24	Waynes-boro No. 27	Benn-dale No. 9
Dependable capacity	$82,000	$209,000	$177,000	$225,000	$467,000	$354,000
Average annual energy	40,000	48,000	44,000	53,000	152,000	75,000
Total	122,000	257,000	221,000	278,000	619,000	429,000

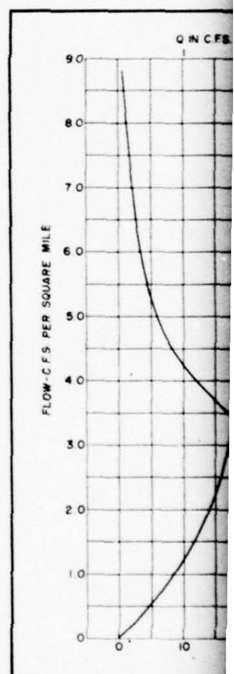
POWER PLANT

The principal dimensions and elevations of the powerhouses were determined from computations based on the average head and horsepower ratings, using the Bureau of Reclamation's "Engineering Monograph No. 20." Horsepower and k.v.a. ratings were based on a generator efficiency of 97 percent and a power factor of 95 percent. The principal dimensions and elevations of the powerhouses are shown in Table 42.

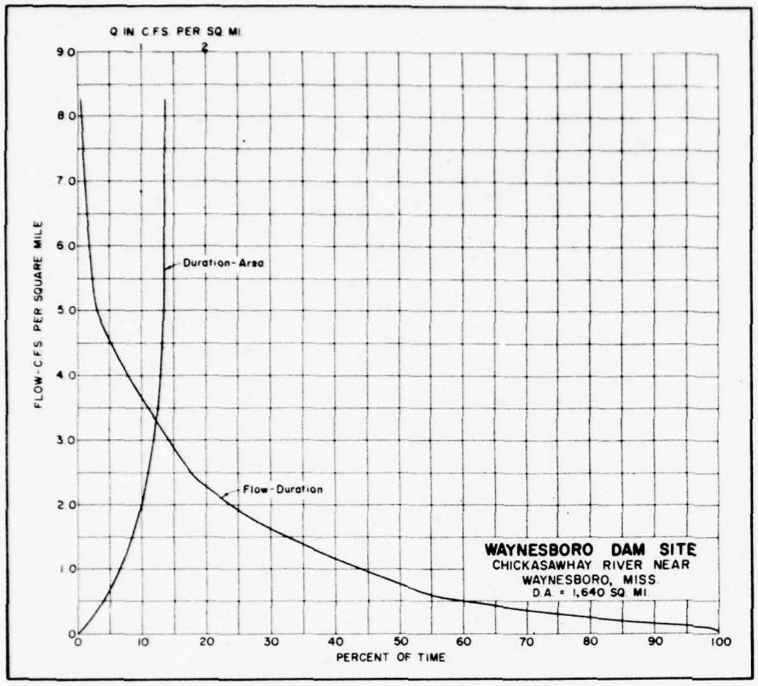

Q IN C.F.S. PER SQ. MI.
FLOW-C.F.S. PER SQUARE MILE
Duration-Area
Flow-Duration
ESCATAWPA RIVER DAM SITES
USED FOR BOTH HARLESTON AND
UPPER ESCATAWPA SITES
HARLESTON D.A. = 583 SQ. MI.
UPPER ESCATAWPA D.A. = 425 SQ. MI.
PERCENT OF TIME

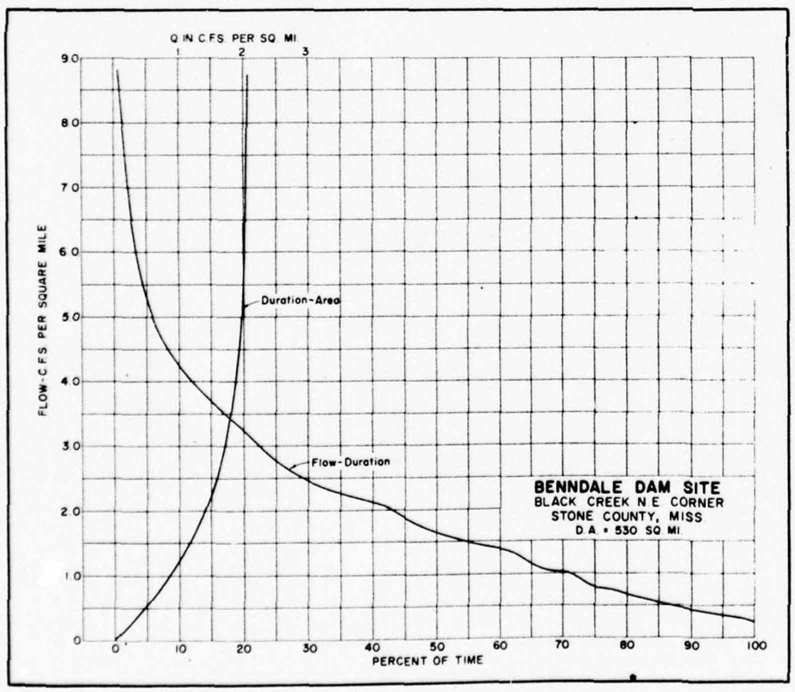

Q IN C.F.S. PER SQ.
FLOW-C.F.S. PER SQUARE MILE


Q IN C.F.S. PER SQ. MI.
FLOW-C.F.S. PER SQUARE MILE
Duration-Area
Flow-Duration
BUCATUNNA DAM SITE
BUCATUNNA CREEK NEAR
BUCATUNNA, MISS.
D.A. = 495 SQ. MI.
PERCENT OF TIME


FLOW-C.F.S. PER SQUARE MILE

2





PASCAGOULA RIVER COMPREHENSIVE BASIN STUDY

FLOW - DURATION AND DURATION - AREA CURVES FOR CONSIDERED POWER PROJECTS

FIGURE 28

Table 42

Principal powerhouse dimensions and elevations

Item	Escatawpa River sites: Harleston No. 1	Escatawpa River sites: Upper Escatawpa No. 2	Escatawpa River sites: No. 1 with No. 2	Bucatunna No. 24	Waynesboro No.27	Benndale No. 9
Unit spacing, feet	45	54.5	67	51	53	46
Elev. generator floor, m.s.l.	76.5	119	84	179	164.5	97
Elev. centerline of distributor, m.s.l.	50.5	91.5	55	153.5	138.5	73
Elev. bottom of draft tube, m.s.l.	17	51	5	115.5	99.5	39
Length, width and height of substructure, feet	55x92x64.5	64.5x99x73	77x107.5x84	61x98x68.5	116x99x70	102x81.5x63
Length, width and height of superstructure, feet	100x67x41.5	119x74x48	144x76x48.5	112x73x47	169x74x47.5	178x55x44
Diameter of turbine,feet	12.8	15.6	19.2	14.6	15.1	13.1
Speed, rpm	133.3	116.1	87.8	128.6	124.1	144
Length of draft tube, feet	53	64	77.5	60	62	54

SINGLE-PURPOSE POWER PROJECTS

Table 43 summarizes the first costs, annual charges, benefits and benefit-to-cost ratios for the considered single-purpose power projects. The project evaluations are based on a 50-year project life and an interest rate of 3.125 percent.

Table 43

Summary of first costs, annual charges, benefits and benefit-to-cost ratios for considered single-purpose power projects (50-year life and 3.125 percent interest rate)

Site No.	Name	First cost ($1,000)	Annual charges ($1,000)	Annual benefits ($1,000)	Benefit-to-cost ratio
1	Harleston	20,600	943	122	0.1
2	Upper Escatawpa	33,870	1,494	257	0.2
*1	Harleston	54,470	2,437	221	0.1
24	Bucatunna	24,560	1,111	278	0.3
27	Waynesboro	43,500	2,125	619	0.3
9	Benndale	35,450	1,569	429	0.3

*With No. 2 in place.

MULTIPLE-PURPOSE PROJECTS

Power could not be considered for inclusion in a multiple-purpose project since the specific costs to power for each site exceeded the power benefits. A summary of specific power facility cost at the sites in contained in Table 44.

Table 44

Summary of first costs, annual charges, benefits and benefit-to-cost ratios for specific power facilities (50-year project life and 3.125 percent interest rate)

Site No.	Name	First cost ($1,000)	Annual charges ($1,000)	Annual power benefits ($1,000)	Benefit-to-cost ratio
1	Harleston	$2,800	200	122	0.6
2	Upper Escatawpa	5,175	351	257	0.7
*1	Harleston	6,050	386	221	0.6
24	Bucatunna	4,925	340	278	0.8
27	Waynesboro	10,150	657	619	0.9
9	Benndale	8,140	522	429	0.8

*With No. 2 in place

PART C — ESTIMATES OF GROSS EROSION AND SEDIMENT YIELDS

INTRODUCTION

The material which follows in this portion of the report was furnished by the U. S. Department of Agriculture, Soil Conservation Service, at the request of and for use by the Corps of Engineers in determining the storage required for sediment accumulation in potential reservoirs.

SUMMARY

Changes in the agricultural economy in the Pascagoula River Basin over the past 20 years have resulted in a relatively low amount of sediment entering the stream system. Studies of annual gross erosion and sediment yields for present conditions in 12 sample watersheds indicate an annual sediment yield ranging from 0.1151 to 0.7241 acre feet per square mile of drainage area. The annual sediment yields, under present

conditions, that would accumulate at 18 potential reservoir sites and pass the 7 designated gaging stations, are:

Site No. or Gaging Station	Drainage Area Sq. Mi.	Annual Sediment Yield Ac. Ft.
1	596 (583)[1]	171 (167)[2]
2	425	118
4	49	7
6	220	60
9	668 (530)[1]	150 (119)[2]
17	431 (422)[1]	178 (174)[2]
18	160	75
20	156 (152)[1]	73 (71)[2]
21	285 (293)[1]	112 (115)[2]
22	152 (150)[1]	54 (53)[2]
23	130	56
24	495	213
25	263	103
27	1640	656
30	90	46
32	70	35
35	111	57
36	95	50
Enterprise	913	419
Shubuta	1460	643
Waynesboro	1660	722
Leakesville	2680	1140
Hattiesburg	1760	668
McLain	3510	1445
Merrill	6600	2759

The drainage areas behind gaging stations are taken from "Geological Survey Water Supply Papers."
[1] Revised drainage area for selected sites. Determined by the U.S.G.S.
[2] Annual sediment yield based on revised drainage areas.

Future land use conditions without potential PL-566 projects in place would reduce these amounts at the Merrill gauge by approximately 44 percent and with potential PL-566 projects in place by approximately 48 percent.

Purpose and Scope of Investigation

The Coordinated Comprehensive Basin Study of the Pascagoula River, Mississippi and Alabama, provides for the U. S. Department of Agriculture, Soil Conservation Service, to furnish estimates of sediment accumulation in potential reservoirs considered by the Corps of Engineers in their project evaluations.

Annual gross erosion and annual sediment yields per square mile of drainage area were estimated for "present and future land use conditions without potential PL-566 projects in place" and "with potential PL-566 projects in place." Future land use estimates are indications of what might be expected to occur in each of the individual watersheds within the Pascagoula River system. They approximate the land use expectations developed in the USDA Conservation Needs Inventory prepared in 1958. Estimates of sediment yield do not include accumulation from stream beds or losses from stream banks.

Description of Pascagoula River Basin

The Pascagoula River and its tributaries drain an area of approximately 9670 square miles located in all, or parts of, twenty-five South Mississippi and Southwest Alabama counties.

Four Land Resource Areas are represented within the Basin. These are, from north to south, the Upper Coastal Plain, Blacklands or Central Prairie, Lower Coastal Plain, and Coastal Flatwoods with a limited acreage of Thin Loess on the Bowie River tributary. The topography ranges from relatively flat in the Coastal Flatwoods to rolling in the Blacklands and steep in certain areas of the Coastal Plains.

Forest land is the dominant land use in each of the three basin study areas followed by pasture land, cropland and other land. Crops and pastures are more significant in the Prairie and Upper Coastal Plain Resource Areas. This dominance of land use is reflected in higher sediment yields within these two resource areas.

Erosion is relatively light in the Lower Coastal Plain and Coastal Flatwoods Resource Areas. Any noticeable areas of gully or severe sheet erosion will be limited to the upper reaches of the basin. Eroding roadbanks contribute a considerable portion of the total sediment yield in all parts of the basin.

Previous Studies

The U. S. Department of Interior, Geological Survey, obtained 39 suspended sediment samples on the Pascagoula River near Benndale, Mississippi, from April 23, 1959, to July 28, 1960. A part of the report follows:

> "Suspended sediment concentration in the Pascagoula River is low. The results of the analyses of random samples collected at various stream discharges are shown in table 17 (not attached). Sediment concentration in the Pascagoula River is related more to the manner in which the river stage is changing than to the volume of water being

discharged. For instance, on April 23, 1959, the sample was collected when the river was rising. The mean daily discharge was 16,000 cfs and the sediment concentration was 165 ppm. On June 9, 1959, the mean daily discharge was 21,300 cfs but the river was falling and the sediment concentration was down to 68 ppm.

"An analysis of the sediment material indicates that approximately 10 percent of the material is organic and 90 percent is inorganic. Approximately six percent of the inorganic residue is presumed to be insoluable silicates."

Generalized Procedures

In developing basic data for sample watersheds, criteria and procedures are in keeping with those established for the Soil Conservation Service. A guide, "Sedimentation Investigation and Preliminary Geologic Site Investigations in Watersheds", is used in estimating sediment accumulation for reservoirs in the USDA Small Watershed Program. Overall procedures for the expansion of this basic data to other watersheds and specific points within the basin were developed by Soil Conservation Service technicians, with specialists in the field of geology and sedimentation.

Land use information, present and future, was derived from USDA Conservation Needs Inventory Data with adjustments made for miscellaneous and non-contributing areas. Acres of gullies, pits, caved roadbanks, and similar type sources of sediment were expanded from sample watersheds to others that were studied in less detail.

Sheet erosion in tons per acre for each land use for present and future conditions was developed on sample watersheds using the Musgrave soil decline equation. This information was weighed and applied to the acreage of the various land uses in the basin. Delivery ratios were taken from the curve, "Delivery Ratios vs. Size of Drainage Area", used by the Soil Conservation Service.

Acres of contributing gullies, roadbanks and pits were added and assigned an annual soil loss of 300 tons per acre under present conditions. This was reduced to 150 tons per acre for the future. A delivery ratio of 60 percent was used in calculating the amount of sand that would accumulate from these sources. Where oil well sites seemed a contributing factor, an annual soil loss of 40 tons per acre and a delivery ratio of 40 percent were used. This was reduced by one-half for future conditions.

The delivered yield of sediment in acre feet was calculated for each sub-watershed using a submerged weight of 60 pounds per cubic

foot or 1300 tons per acre foot. The average yield per square mile of drainage area was then determined.

Weighted yields per square mile for sub-watersheds involved were expanded to the area of the various structures proposed by the Corps of Engineers.

In computing present and future sediment accumulation with PL-566 projects in place, the economic feasibility of projects and the degree of control offered by structural measures were taken into consideration.

For tabulation purposes, the annual sediment yield in acre feet per square mile of drainage area was adjusted to the nearest hundredth.

Results of Investigation

Estimates of annual gross erosion and sediment yield have been accumulated for the 54 sub-watersheds in the Pascagoula River Basin. These estimates are expressed in "tons", "acre feet", and "acre feet per square mile of drainage area" for present and future land use conditions and with the assumption that these watersheds would and would not be potential PL-566 watershed projects.

Estimates of annual gross erosion and sediment yield were then calculated for the 18 potential reservoir sites and 7 gaging stations.

Sub-Watersheds Comprising Area
Behind Potential Corps of Engineers Reservoirs
in the Pascagoula River Basin

Potential Reservoirs	Project	Sub-Watershed
1	Harleston	A2,43-A3,44*,A4*
2	Upper Escatawpa	A2,43-A3*
4	Vancleave	46*
6	Perkinston	39*
9	Benndale	36,37*,40*
17	Taylorsville	10,11,18*
18	Richton	28*
20	Tallahala	16*
21	Bowie	23*
22	Mize	17*
23	Leakesville	34*
24	Bucatunna	7,9,15,22,26,15a-A1*
25	Manasse	7,9,15*,22*
27	Waynesboro	1,2,3,4,5,6,8,13,14*, 19,25*
30	Rose Hill	13*
32	Graham	3*
35	Moss	12*
36	Tallasher	2*

*Portion only

DAMSITE — POTENTIAL RESERVOIR 1

596 Sq. Mi. - Escatawpa River - Jackson County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	1993	Not Feasible
Future Land Use	1247	" "
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.29	Not Feasible
Future Land Use	.16	" "
Annual Sediment Yield - Ac. Ft.		
Present Land Use	171	Not Feasible
Future Land Use	95	" "

DAMSITE — POTENTIAL RESERVOIR 2

425 Sq. Mi. - Escatawpa River - Mobile County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	1916	Not Feasible
Future Land Use	1179	" "
Annual Sediment Yield (Ac.Ft./Sq. Mi. D.A.)		
Present Land Use	.28	Not Feasible
Future Land Use	.15	" "
Annual Sediment Yield - Ac. Ft.		
Present Land Use	118	Not Feasible
Future Land Use	65	" "

DAMSITE — POTENTIAL RESERVOIR 4

49 Sq. Mi. - Bluff Creek - Jackson County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	771	Not Feasible
Future Land Use	583	" "
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.14	Not Feasible
Future Land Use	.08	" "
Annual Sediment Yield - Ac. Ft.		
Present Land Use	7	Not Feasible
Future Land Use	4	" "

DAMSITE — POTENTIAL RESERVOIR 6

220 Sq. Mi. - Red Creek - Stone County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	3149	Not Feasible
Future Land Use	1877	" "
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.27	Not Feasible
Future Land Use	.15	" "
Annual Sediment Yield - Ac. Ft.		
Present Land Use	60	Not Feasible
Future Land Use	34	" "

DAMSITE — POTENTIAL RESERVOIR 9

668 Sq. Mi. - Black Creek - Stone County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	2563	Not Feasible
Future Land Use	1651	" "
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.22	Not Feasible
Future Land Use	.13	" "
Annual Sediment Yield - Ac.Ft.		
Present Land Use	150	Not Feasible
Future Land Use	87	" "

DAMSITE — POTENTIAL RESERVOIR 17

431 Sq. Mi. - Leaf River - Smith County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4779	3987
Future Land Use	2996	2533
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.41	.37
Future Land Use	.24	.22
Annual Sediment Yield - Ac. Ft.		
Present Land Use	178	159
Future Land Use	104	93

DAMSITE — POTENTIAL RESERVOIR 18

160 Sq. Mi. - Thompson Creek - Perry County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	5195	Not Feasible
Future Land Use	2410	" "
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.47	Not Feasible
Future Land Use	.22	" "
Annual Sediment Yield - Ac. Ft.		
Present Land Use	75	Not Feasible
Future Land Use	36	" "

DAMSITE — POTENTIAL RESERVOIR 20

156 Sq. Mi. - Tallahala Creek - Jasper County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4325	Not Feasible
Future Land Use	2567	" "
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.47	Not Feasible
Future Land Use	.26	" "
Annual Sediment Yield - Ac.Ft.		
Present Land Use	73	Not Feasible
Future Land Use	40	" "

DAMSITE — POTENTIAL RESERVOIR 21

285 Sq. Mi. - Bowie Creek - Covington County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4209	3374
Future Land Use	2588	2075
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.39	.33
Future Land Use	.22	.19
Annual Sediment Yield - Ac. Ft.		
Present Land Use	112	95
Future Land Use	63	54

DAMSITE — POTENTIAL RESERVOIR 22

152 Sq. Mi. - Oakohay Creek - Smith County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	3888	3647
Future Land Use	2467	2314
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.35	.34
Future Land Use	.21	.20
Annual Sediment Yield - Ac. Ft.		
Present Land Use	54	52
Future Land Use	31	30

DAMSITE — POTENTIAL RESERVOIR 23

130 Sq. Mi. - Big Creek - Greene County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	3962	Not Feasible
Future Land Use	2230	" "
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.43	Not Feasible
Future Land Use	.23	" "
Annual Sediment Yield - Ac. Ft.		
Present Land Use	56	Not Feasible
Future Land Use	30	" "

DAMSITE — POTENTIAL RESERVOIR 24

495 Sq. Mi. - Bucatunna Creek - Wayne County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4042	Not Feasible
Future Land Use	2497	" "
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.43	Not Feasible
Future Land Use	.25	" "
Annual Sediment Yield - Ac.Ft.		
Present Land Use	213	Not Feasible
Future Land Use	122	" "

DAMSITE — POTENTIAL RESERVOIR 25

263 Sq. Mi. - Bucatunna Creek - Clarke County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	3644	Not Feasible
Future Land Use	2387	" "
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.39	Not Feasible
Future Land Use	.24	" "
Annual Sediment Yield - Ac. Ft.		
Present Land Use	103	Not Feasible
Future Land Use	62	" "

DAMSITE — POTENTIAL RESERVOIR 27

1640 Sq. Mi. - Chickasawhay River - Wayne County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4431	3837
Future Land Use	2651	2318
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.44	.39
Future Land Use	.24	.22
Annual Sediment Yield - Ac. Ft.		
Present Land Use	714	646
Future Land Use	400	366

DAMSITE — POTENTIAL RESERVOIR 30

90 Sq. Mi. - Souinlovey Creek - Clarke County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	3921	Not Feasible
Future Land Use	2365	" "
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.51	Not Feasible
Future Land Use	.29	" "
Annual Sediment Yield - Ac. Ft.		
Present Land Use	46	Not Feasible
Future Land Use	26	" "

DAMSITE — POTENTIAL RESERVOIR 32

70 Sq. Mi. - Tallahatta Creek - Lauderdale County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4363	3509
Future Land Use	2639	2122
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.50	.43
Future Land Use	.29	.26
Annual Sediment Yield - Ac. Ft.		
Present Land Use	35	30
Future Land Use	20	18

DAMSITE — POTENTIAL RESERVOIR 35

111 Sq. Mi. - Tallahoma Creek - Jasper County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4581	3337
Future Land Use	2823	2056
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.51	.40
Future Land Use	.30	.23
Annual Sediment Yield - Ac. Ft.		
Present Land Use	57	44
Future Land Use	33	26

DAMSITE — POTENTIAL RESERVOIR 36

95 Sq. Mi. - Tallasher Creek - Newton County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	6137	3980
Future Land Use	3615	2344
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.53	.44
Future Land Use	.34	.25
Annual Sediment Yield - Ac. Ft.		
Present Land Use	50	42
Future Land Use	32	24

ENTERPRISE GAGE

913 Sq. Mi. - Chickasawhay River - Clarke County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4682	3454
Future Land Use	2802	2114
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.46	.37
Future Land Use	.26	.22
Annual Sediment Yield - Ac. Ft.		
Present Land Use	419	340
Future Land Use	237	198

SHUBUTA GAGE

1460 Sq. Mi. - Chickasawhay River - Clarke County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without Pl-566	With PL-566
Present Land Use	4316	3586
Future Land Use	3637	2228
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.44	.39
Future Land Use	.24	.22
Annual Sediment Yield - Ac. Ft.		
Present Land Use	643	568
Future Land Use	350	327

WAYNESBORO GAGE

1660 Sq. Mi. - Chickasawhay River - Wayne County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4431	3837
Future Land Use	2651	2318
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.43	.39
Future Land Use	.24	.22
Annual Sediment Yield - Ac. Ft.		
Present Land Use	722	653
Future Land Use	405	370

LEAKESVILLE GAGE

2680 Sq. Mi. - Chickasawhay River - Greene County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4270	3909
Future Land Use	2552	2349
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.43	.40
Future Land Use	.24	.23
Annual Sediment Yield - Ac. Ft.		
Present Land Use	1140	1072
Future Land Use	639	604

HATTIESBURG GAGE

1760 Sq. Mi. - Leaf River - Forrest County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4108	3398
Future Land Use	2733	2268
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.38	.33
Future Land Use	.23	.20
Annual Sediment Yield - Ac. Ft.		
Present Land Use	668	586
Future Land Use	403	356

MCLAIN GAGE

3510 Sq. Mi. - Leaf River - Green County

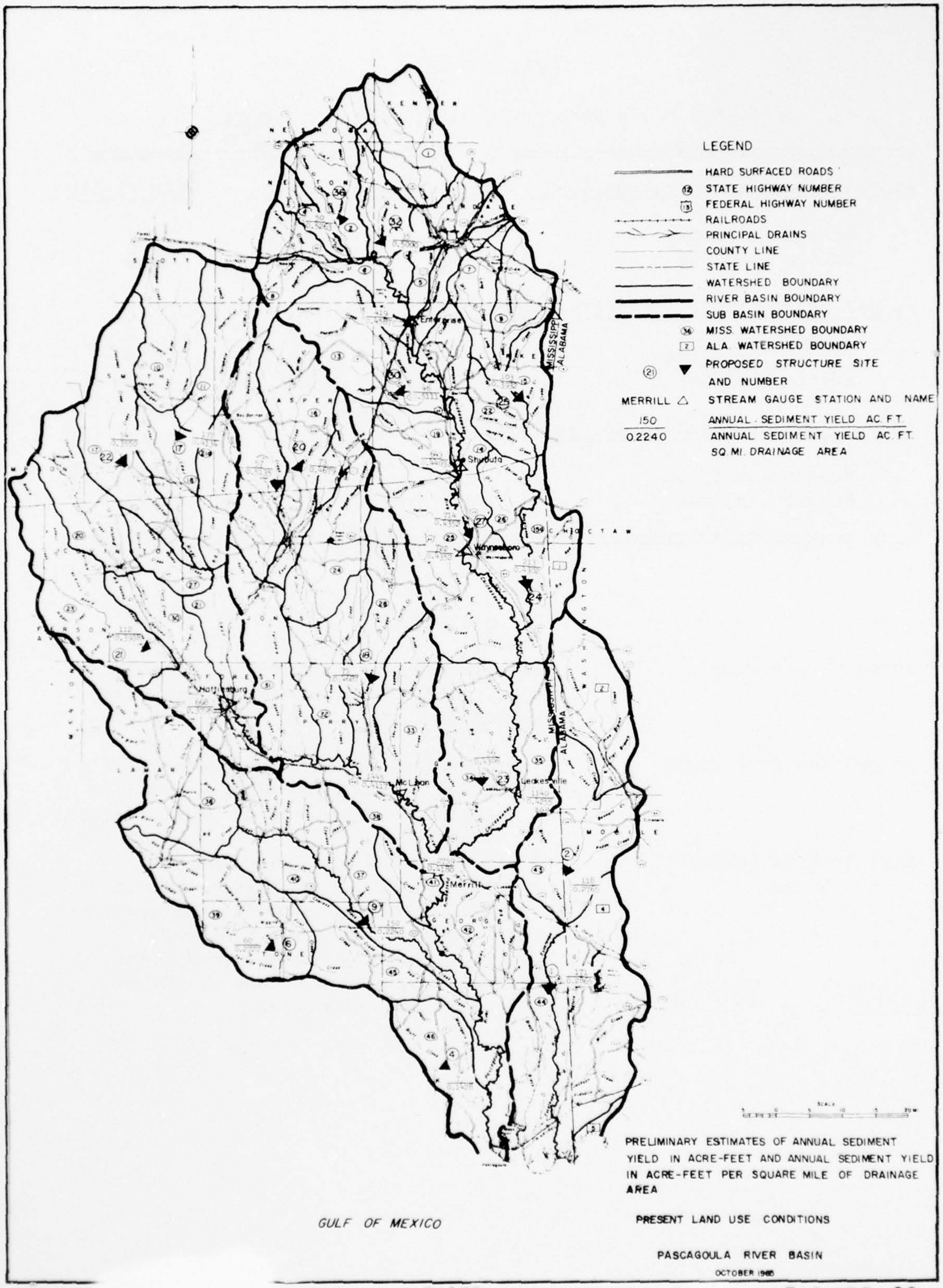
Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4428	4015
Future Land Use	2658	2386
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.41	.38
Future Land Use	.23	.21
Annual Sediment Yield - Ac. Ft.		
Present Land Use	1445	1340
Future Land Use	812	752

MERRILL GAGE

6600 Sq. Mi. - Pascagoula River - George County

Annual Gross Erosion (Tons/Sq.Mi. D.A.)	Without PL-566	With PL-566
Present Land Use	4356	3966
Future Land Use	2609	2369
Annual Sediment Yield (Ac.Ft./Sq.Mi. D.A.)		
Present Land Use	.42	.39
Future Land Use	.23	.22
Annual Sediment Yield - Ac. Ft.		
Present Land Use	2759	2575
Future Land Use	1548	1448

	Definition
Annual Gross Erosion:	All erosion, both sheet and channel-type, occurring in an area - expressed as tons/sq. mi.
Annual Sediment Yield:	The amount of sediment carried out of a watershed or past a measuring point in a watershed - expressed as ac.ft./sq. mi.
Acre Foot of Sediment:	One acre of sediment one foot deep (43,560 Cu. Ft.). In this report it is assumed that an acre-foot of sediment would weigh about 1,300 tons when deposited under submerged conditions. This was based on a volume weight of 60 pounds per cubic foot.



PRELIMINARY ESTIMATES OF ANNUAL SEDIMENT YIELD IN ACRE-FEET AND ANNUAL SEDIMENT YIELD IN ACRE-FEET PER SQUARE MILE OF DRAINAGE AREA

PRESENT LAND USE CONDITIONS

PASCAGOULA RIVER BASIN

OCTOBER 1965

FIGURE 29